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ENERGY

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JPRS-UEN-84-032

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USSR REPORT

ENERGY

CONTENTS

FUELS

OIL AND GAS

GENERAL

OIL AND GAS

UDC 622.24.084.3

IMPROVEMENT OF DRILLING IN WESTERN SIBERIA SOUGHT

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 5, May 84 pp 15-19

[Article by V. A. Glebov, V. D. Razuvayev, A. G. Anopin and V. A. Shashkov, Saratovneftegaz, and M. O. Krist, All-Union Scientific Research Institute of Drilling Equipment]

[Text] The Yershov UBR [Administration of Drilling Operations] of the association Saratovneftegaz began to work in Western Siberia by the watch-expeditionary method in 1977. Whereas the annual sinking comprised 77,000 meters in 1978, it increased to 730,000 meters in 1983. This was achieved by improving all the technical and economic indicators of well drilling.

The rate of increase of the total sinking surpasses the rate of increase of the number of drilling brigades almost threefold, i.e., its growth is determined mainly by an increase of the labor productivity of drilling brigades. The average sinking per drilling brigade increased from 21,000 meters in 1978 to 62,000 meters in 1983.

The primary task of the collective of the Yershov UBR, which previously drilled deep weels in Saratov Oblast under conditions sharply different from Siberian conditions, was to study the experience of the technology of sinking wells and to organize the drilling work of drilling enterprises working in Western Siberia, while its future task is to achieve the same technical and economic indicators or ones close to them. A total of 270 measures, directed toward improvement of organization of work and introduction of leading experience, was implemented during the years of work of the collective in Western Siberia. The widely organized socialist competition among the drilling brigades and other services of the UBR played an important role in completion of the planned volumes of work.

At the same time, the depth of drilled wells increased with the years, the complexity of sinking them increased and in 1982 the increase in the rate of drilling stopped.

A considerable decrease of the technical and economic indicators [1, 2] was observed at the Bystrino field in sinking wells 2,800-3,000 meters deep compared to drilling those 2,300-2,500 meters deep. Therefore, improvement of drilling technology acquired main significance. Investigations on the given problem were conducted in 1982 mainly in four directions:

development and introduction of small-capacity drilling technology;

use of the water jet effect;

improvement of the method of preparation and use of polymer drilling muds;

introduction of a three-stage system of cleaning drilling mud.

The extensively employed technology of drilling throughout Western Siberia provides for sinking the entire well after lowering the jig with delivery of drilling pumps with capacity of 42-44 liter/s. Hydraulic calculations of this technology (Table 1) reveal the following unsatisfactory indicators in the drilling program:

high differential pressures (7.05-14.8 MPa);

a sharp decrease of hydraulic power at the bottom of the well with an increase of depth (from 289.2 to 21.5 kW);

a sharp decrease of the flow rate of the drilling mud with depth (from 102 to 20-32 m/s);

a significant increase of the ascending flow between the turbodrill and walls of the well (up to 6.5 m/s), which leads to the occurrence of increased erosion loads on the walls of the well and as a result, to formation of caverns in terrigenous deposits with deterioration of the quality of the shaft and strengthening of its operational columns.

The hydraulics of high-capacity drilling technology becomes less balanced as drilling depth increases from 1,500 to 3,000 meters. The total hydraulic drag increases, especially in the space of the wells around the pipe. Limitation of the permissible working pressure in the delivery line of drilling pumps determines the use of bits with central flushing. Therefore, the hydraulic output at the bottom decreases to a minimum. Thus, the existing technology inhibits a further increase of drilling indicators: sinking per bit and mechanical rate. The drag presented in Table 1 can be reduced, as shown by investigations, by reducing the flow rate of the drilling mud from 42-44 to 24 liters/s in the range of 1,500-3,000 meters and below. This provides normal cleaning of the bottom and removal of slurry. Introduction of this drilling technique using the A7P3 turbodrill permitted an increase of sinking per bit by 39 percent and an increase of the mechanical and commercial rate by 19 and 41 percent, respectively, when drilling wells 3,000 meters deep [1].

The water jet effect is of important significance when drilling soft rock, with which the profile of deposits of Western Siberia is mainly represented. A considerable increase of sinking per bit and mechanical rate is achieved at flow rate of drilling mud more than 100 m/s. The results of hydraulic calculations showed that the flow rate of drilling mud must be reduced to 18-24 liters/s to maintain specific hydraulic output at the bottom when drilling deep wells. A flow rate of drilling mud from them up to 140 m/s at depth of

Table 1.

Интервал бурения, м (1)	Расход бурового раствора, л/с (2)	Дифференциальное давление, МПа (3)	Сопротивление в затрубном пространстве, МПа (4)	Диаметр сменных насадок, мм (5)	Скорость истечения бурового раствора, м/с (6)	Перепад давления в насадках, МПа (7)	Гидравлическая мощность на забое, кВт (8)	Гидропотери, МПа (9)				Скорость восходящего потока в затрубном пространстве, м/с (14)	Вид двигателя (15)
								в обвязке насосов (10)	в бурильных трубах и УБТ (11)	в забойном двигателе (12)	суммарные (13)		
До 1500 (16)	44	7,05	4,65	13,5	102	6,7	289,2	1,66	3,15	4,8	21	6,5	3ТСШ195ТЛ (17)
	24	3,79	1,39	8,9	130	10,60	249,5	0,49	1,02	7,50	21	3,5	А7П3 (18)
	20	3,37	0,97	7,5	154	14,00	302,1	0,34	0,73	4,90	21	2,9	А7П3
1500—2000	44	9,01	5,81	15	83	4,70	202,9	1,66	4,01	4,8	21	6,5	3ТСШ 195ТЛ
	24	4,93	1,73	9	126	10,00	296,7	0,49	1,30	7,50	21	3,5	А7П3
	20	4,41	1,21	7,5	154	13,60	302,1	0,34	0,93	4,90	21	2,9	А7П3
2000—2500	44	10,96	6,96	17	65	2,70	116,5	1,66	4,84	4,8	21	6,5	3ТСШ 195ТЛ
	24	6,08	2,05	9,1	123	9,40	289,6	0,49	1,58	7,50	21	3,5	А7П3
	20	5,45	1,45	7,7	144	13,20	282,5	0,34	1,13	4,90	21	2,9	А7П3
2500—3000	44	12,91	8,11	24	32	0,70	30,2	1,66	5,69	4,8	21	6,5	3ТСШ 195ТЛ
	24	7,22	2,42	9,5	114	8,70	268,4	0,49	1,89	7,50	21	3,5	А7П3
	20	6,49	1,69	7,7	144	12,75	282,5	0,34	1,33	4,90	21	2,9	А7П3
3000—3500	44	14,82	9,22	ЦВ	20	0,50	21,5	1,66	6,54	4,8	23	6,5	3ТСШ 195ТЛ
	24	8,37	2,77	9,5	110	8,10	258,9	0,49	2,14	7,50	21	3.5	А7П3
	20	7,53	1,93	7,9	136	12,30	266,8	0,34	1,53	4,90	21	2,9	А7П3

Note. The maximum pressure of the U8-6M pump at filling coefficient of 0.85 is 21 MPa.

[Key on following page]

[Key continued from preceding page]:

1. Drilling range
2. Consumption of drilling mud, liter/s
3. Differential pressure, MPa
4. Resistance in space beyond pipe, MPa
5. Diameter of replaceable nozzles, mm
6. Flow rate of drilling mud, m/s
7. Pressure drop in nozzles, MPa
8. Hydraulic output at bottom, kW
9. Hydraulic losses, MPa
10. In pump bracing
11. In drill strings and extra-strong drilling pipe
12. In bottom motor
13. Total
14. Rate of ascending flow in space around pipe, m/s
15. Type of motor
16. Up to
17. 3TSSh195TL
18. A7P3

3,000 meters or more can be achieved by installation of replaceable nozzles of the corresponding diameters in the bit, using a pressure drop in the bit up to 10-12 MPa. This was confirmed by investigations conducted in test-production wells [2].

Industrial tests of NR-5 drilling mud based on acrylic polymers, developed at the KB [design office] of the association Saratovneftegaz, were conducted for the first time in Western Siberia at the Bystrino field. An assembly for centralized preparation of the polymer reagent was constructed from the "wet" waste of nitron fiber at the base of the Bystrino expedition. It made it possible for the drilling brigades to do away with preparation of the reagent at the drilling rig. Two additional assemblies were subsequently constructed for full support with polymer reagent. An installation for preparation of polymer concentrate was also developed at the KB of the association Saratovneftegaz.

The use of polymer reagent in Western Siberia is related to solution of the following combination of problems:

1) an increase of the lubricating and antiseizure indices of the drilling mud when the flow rate of oil is reduced to production needs;

2) a reduction of the density of drilling muds and of their rheological properties to increase the technical and economic indicators of drilling and to prevent hydraulic ruptures of the bed;

3) an increase of the stability of the well walls and stability of the drilling mud;

4) a reduction of the nomenclature of the chemical reagents used and a reduction of their flow rate to treat the drilling muds.

Gradual conversion of all drilling brigades of the Bystrino expedition to drilling by using polymer reagent occurred during 1982, as a result of which the flow rate of oil was almost one-fourth as much in the investigated wells.

A guarantee against seizures of the drilling tools during drilling was the low adhesion of the clay crust, which was controlled under field conditions in the Zhukhovitskiy device, improved at the KB of the association Saratovneftegaz. The low filtration of the drilling mud and the favorable chemical composition of the filtrate made it possible to avoid development of a solid phase, due to which the increase of viscosity of the mud over time was retarded.

Not one hydraulic rupture of the bed was noted when drilling the wells. The stability of the well walls was increased significantly. The time expenditures for preparatory-auxiliary operations (working up, rinsing, treatment and preparation of the drilling mud, equalization of the density of the mud and maintaining the turbodrill) were reduced per 1,000 meters of sinking from 14.54 hours in 1981 to 10.23 hours in 1983, i.e., by 44 percent.

The use of polymer reagent made it possible to stabilize not only the filtration index of the mud in the range of 4-6 cm^3, but also its other parameters, density--1.10-1.14 g/cm^3, relative viscosity--18-25 s and SNS [not further identified]--0/0 Pa. The strength of the lubricating film, measured on a four-sphere friction machine, was 2,570-2,790 MPa. The drilling mud was supplemented during drilling with circulating water with additives of polymer reagent. As a result, there was no need to use viscosity reduction reagents: TPFN [not further identified], GMFN [not further identified], igetane and nitrolignin. The consumption of KMTs [not further identified] per meter of sinking was reduced from 0.4 to 0.056 kg and of oil from 0.015 to 0.007 m^3, while the use of GMFN, sulfonol and graphite was completely eliminated after introduction of polymer drilling muds at the Lyantor expedition. The consumption of nitron reagent was 0.005 m^3 per meter of sinking.

One of the important directions for increasing the technical and economic indicators of drilling operations is a reduction of the density of the drilling mud and of the content of the solid phase in it. According to data of VNIIKRneft' [not further identified], the two-stage system of cleaning the drilling mud, consisting of VS-1 or SV-2B vibrosite and a PG-50 hydrocyclone, provides cleaning of only 30-40 percent of drilling mud. The density of the drilling mud when drilling in mainly clay rock alternating with sands, sandstones and aleurolites, was increased with this system of cleaning due to the constant enrichment of the drilling mud with the drilled rock. At the same time, the density of the drilling mud due to gradients of bed pressures should not exceed 1.09-1.12 g/cm^3 in the promising Yuzhno-Yagunsk and Kogalyma fields, which the Yershov UBR services.

A primary task posed to the drilling brigades of the Yershov UBR was to bring the density of the drilling mud up to the values provided in the geological engineering order. The use of polymer drilling mud and the installation for the third stage of cleaning it--the IG-45 silt separator--made it possible to solve the given problem. During operation of the silt separator for one-two circulation cycles, the density of the drilling mud is reduced by 0.02-0.03

g/cm within 3-4 hours. The silt separator is put into operation in the middle of the first cut (at a depth of 800-900 meters) at the moment when the solid phase in the drilling mud begins to develop. The total operating time of the silt separator comprises 70-80 percent of the time expended on mechanical drilling.

Reduction of the content in the solid phase of the drilling mud increases the mechanical rate of sinking per bit and also reduces the time of repair operations of the drilling pump and of the manifold lines by 36 and 42 percent, respectively.

Table 2

(1) Буровой раствор	Число сравниваемых скважин (2)	Средняя глубина скважины, м (3)	Общая проходка, м (4)	Число долот (5)	Проходка на долото, м (6)	Время механического бурения, ч (7)	Механическая скорость, м/ч (8)
(9) Стандартный	16	2436	38 982	175	222,7	1021	38,18
Полимерный (10)	80	2377	190 153	702	270,9	4676	40,67
(11) Стандартный с двухступенчатой очисткой	5	2337	11 683	51	229,1	388	30,1
(12) Полимерный с трехступенчатой очисткой	12	2343	28 094	95	290,7	600	43,8

Key:

1. Drilling mud
2. Number of wells compared
3. Average depth of well, meters
4. Total sinking, meters
5. Number of bits
6. Sinking per bit, meters
7. Mechanical drilling time, hr
8. Mechanical rate, m/hr
9. Standard
10. Polymer
11. Standard with two-step cleaning
12. Polymer with three-step cleaning

The indicated elements of the new technology are a single complex, directed toward increasing sinking per bit and the mechanical rate of drilling by using the low-capacity drilling technology [1], by utilizing the water jet effect [2] and by using polymer drilling mud and the IG-45 silt separator. Data that show the effectiveness of the new technology are presented in Table 2.

An increase of the commercial and mechanical rates of sinking per bit was achieved by reducing the differential pressure, related to a reduction of the consumption, improvement of the rheological characteristic and lubricating capacity and by reduction of the density of the drilling mud and also due to optimum use of the water jet effect. An increase of the commercial rate was also achieved by improving the time balance by reducing the length of lowering and hoisting operations and preparatory-auxiliary and repair operations. The time expenditures to eliminate complications and accidents per 1,000 meters of sinking was reduced from 4.4 days in 1981 to 1.07 days in 1983.

In sum, the use of the new technique of drilling wells made it possible to increase sinking per drilling brigade by 9,000-10,000 meters/year (Table 3).

Table 3

(1) Технология бурения	(2) Прирост проходки на одну буровую бригаду, м, за счет увеличения		(5) Проходка на одну буровую бригаду, м
	(3) проходки на долото	(4) механической скорости бурения	
(6) Высоколитражная	—	—	52 400
(7) Низколитражная	3763	941	57 104
(8) До гидромониторного эффекта	—	—	52 400
(9) После гидромониторного эффекта	845	211	53 456
(10) Применение бурового раствора:			
(11) стандартного	—	—	52 400
полимерного (12)	2160	538	55 088
(13) Система очистки:			
(14) двухступенчатая	—	—	52 400
(15) трехступенчатая	922	230	53 552
Принятая (16)	—	—	52 400
(17) Новая	—	—	62 000

Key:
1. Drilling technology
2. Increase of sinking per drilling brigade, m, by increasing
3. Sinking per bit
4. Mechanical rate of drilling
5. Sinking per drilling brigade, meters
6. High-capacity
7. Low-capacity
8. Before water jet effect
9. After water jet effect
10. Using drilling mud
11. Standard
12. Polymer
13. Cleaning system
14. Two-step
15. Three-step
16. Adapted
17. New

The volume of introduction of the indicated elements of the production complex comprised 60-75 percent in 1983. To introduce the measures of the new technique on scales of Western Siberia, one must:

organize serial output of low-capacity bottom motors, for example, of type A7P3, developed by the Laboratory of High-Torque Turbodrills of VNIIBT [All-Union Scientific Research Institute for Drilling Techniques] and successfully introduced by the Yershov UBR;

to provide serial output of new designs of chucks for turbodrills of type ShD or ShFD with seals that permit passage of a minimum amount of drilling mud through the nipple, and to fully utilize the water jet effect in turbine drilling;

to provide drilling enterprises with replaceable nozzles to drill bits 9, 9.5, 10 and 10.5 mm in diameter;

to create a raw material base for production of NR-5 nitron reagent.

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6521
CSO: 1822/326

UDC 622.244.6

FORMATION TESTER USE EVALUATED AT TIMAN-PECHORA OIL, GAS PROVINCES

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 5, May 84 pp 20-21

[Article by Yu. V. Semenov and V. R. Trebs, Arkhangel'sk Division of All-Union Scientific Research Geological Prospecting Petroleum Institute]

[Text] Bed testers (KII [illegible]46, KII 2M-95-GrozUfNII) were used extensively when drilling test-prospec[illegible]ng wells in Timan-Pechora province, which permitted a significant increase of the efficiency of geological prospecting operations. The main methods of using them at the association Arkhangel'skgeologiya are presented in Table 1.

It was established as a result of analyzing the factual data on testing the wells during drilling in the given region that the success rate of operations increased from 66.6 percent in 1975 to 91.04 percent in 1983 and comprised an average of 82.47 percent during this period. This index was brought up to an average of 87 percent throughout the Soviet Union and corresponds to the level achieved abroad.*

Clear data on the nature of saturation of the collectors with bed fluids were found for 303 of 386 tested objects (see Table 1) and clay mud or a filtrate of it with different content of bed fluids or generally without them was sampled from only 83 objects (21.5 percent) upon testing. These results do not permit the geological service to make substantiated conclusions about the test objects, since they cannot be clearly interpreted. More extensive analysis of tests using supplementary geological field data showed that the absence of an influx in 46.1 percent of the cases upon testing was determined by unsuccessful sampling of the production conditions and an influx was not observed in the remaining cases due to the practical absence of a collector in the range of investigation.

Despite the accumulated experience in the field of using bed testers during drilling, doubts frequently arise in the results and intervals of secondary testing are experienced after lowering of the operating column by the usual

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* N. F. Ryazantsev, M. L. Karnaukhov and A. Ye. Belov, "Ispytaniye skvazhin v protsesse bureniya" [Testing Wells During Drilling], Moscow, Izdatel'stvo "Nedra", 1982.

Table 1.

Годы (1)	Число (2)							
	операций с испытателями пластов в необсаженных скважинах в процессе бурения (3)	скважин, в которые спускали испытатель пластов (4)	испытанных объектов (5)	объектов, из которых получены (6)				объектов, из которых притока не получено (11)
				нефть, газ (7)	минерализованная вода (8)	глинистый раствор и его фильтрат (9)	смесь пластового флюида с глинистым раствором или фильтратом (10)	
1975	27	4	18	1	7	1	2	7
1976	35	12	25	2	10	—	6	7
1977	50	20	42	7	15	2	9	9
1978	73	25	56	6	14	1	10	25
1979	68	22	53	4	17	3	13	16
1980	39	16	32	3	12	4	5	8
1981	53	22	44	2	17	7	5	13
1982	56	21	55	3	18	1	7	26
1983	67	24	61	5	16	5	2	33

Key:

1. Years
2. Number
3. Of operations with bed testers in uncased wells during drilling
4. Wells into which bed tester was lowered
5. Test objects
6. Objects from which were produced
7. Oil and gas
8. Mineralized water
9. Clay mud and filtrate of it
10. Mixture of bed fluid and clay mud or filtrate
11. Objects from which no influx was produced

method. In this regard, we analyzed the similarity of the test results by two methods. In the given case, differences were found in only 11 of 46 objects. Thus, no influx was noted in pipes from these objects when using a bed tester, while influxes of bed fluids were obtained when testing in a casing string. However, they were insignificant. For example, after the complex of measures to intensify the call of influx (hydrochloric acid treatments, hydraulic rupture using the PGD-BK-100 powder pressure generator and heat-gas-chemical effects on the bed using an ADS-6), an influx of bed water with oil in a volume of 0.5 m^3 for 5 hours of standing in the influx was observed from interval 2,440-2,448 m in Vaneyvisskaya well 2 upon reduction of the level to 1,640 m; an influx of oil with yield of 4.9 m^3/day at mean dynamic level of 1,800 m was achieved from interval 2,047-2,053 m in Yareyyuskaya well 31 and so on.

The success rate of using bed testers in pipes was determined by acceleration of geological prospecting operations and by the rejection of well reinforcement, which were unproductive according to results of testing them during drilling. The technical and economic indicators of sampling and testing wells during 1975-1983 (Table 2) were used to calculate the saving from using them for the association Arkhangel'skgeologiya. The average cost of testing a single object comprises: 132,730 rubles in casing string and 27,820 rubles

when using bed testers during drilling. The test time can be reduced by an average of 33.7 days when testing a single object using bed testers during drilling.

Table 2

(1) Показатели	Годы (2)								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
(3) Средняя глубина испытываемых скважин, м	2620	3052	2632	2673	2350	2253	2860	2469	2691
Число объектов: (4)									
(5) испытанных всеми способами (6)	47	65	96	112	131	130	93	105	146
с помощью испытателей пластов:	23	39	54	64	61	35	55	56	66
(7) в процессе бурения	18	25	42	56	53	32	44	55	61
(8) в обсаженной скважине	5	14	12	8	8	3	11	1	5
(9) Число скважин:									
(10) ликвидированных как непродуктивные, со спущенными колоннами	1	4	—	—	3	7	3	4	2
(11) ликвидированных без спуска эксплуатационных колонн (геологические задачи полностью решены с помощью испытателей пластов)	2	2	2	4	4	7	10	8	10
(12) Средняя продолжительность испытания одного объекта, сут:									
(13) обычным способом	26,96	31,32	26,40	38,64	45,16	37,41	44,0	41,0	31,96
с помощью испытателя пластов в процессе бурения (14)	—	—	—	2,44	3,34	6,39	1,65	2,97	2,7

Key:

1. Indicators
2. Years
3. Average depth of tested wells, m
4. Number of objects
5. Tested by all methods
6. Using bed testers
7. During drilling
8. In cased well
9. Number of wells
10. Eliminated as non-productive with lowered strings
11. Eliminated without lowering of operating strings (geological problems are completely resolved by using bed testers)
12. Average duration of testing of one object, days
13. By ordinary method
14. Using bed testers during drilling

The actual expenditures to test 386 objects by using them comprise $27.82 \cdot 386 \approx$ ≈ 10.739 million rubles, which is 40.495 million rubles less than expenditures in testing by the ordinary method.

Taking into account that 46 of the objects were also tested in the string to refine their quantitative characteristics, one must exclude the expenditures on testing them from the total sum. The saving is equal to 35.669 million rubles in this case.

Moreover, one should eliminate expenditures on 82 operations which were technically unsuccessful due to malfunctions in the test instruments, leaking of the packers and drill pipe, poor condition of the well shaft and so on. The final saving comprises 33.388 million rubles.

In this case the time, amount of funds and number of materials are reduced due to rejection of lowering operating strings into the wells, which are unproductive according to the results of testing using bed testers lowered in pipes.

The use of bed testers in testing objects during drilling made it possible to fully solve the geological problems during 1975-1983 without lowering operating strings in 47 wells, as a result of which 131,243 meters of casing string 146 mm in diameter and approximately 1,450 tons of cement were saved.

More extensive use of bed testers for testing beds during drilling will considerably increase the effectiveness of test-prospecting operations. The results obtained during testing, carried out according to production requirements, and clearly interpreted (using additional geological and geophysical material), are quite reliable.

6521
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DEEP WELL DRILLING UNDER ANOMALOUS CONDITIONS EXAMINED

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 5, May 84 pp 66-68

[Article by V. S. Blokhin and V. D. Terent'yev]

[Text] A scientific and technical conference, held in October 1983 at Orenburg, was devoted to solution of the problem of increasing the efficiency of drilling deep wells under complex conditions (slides and manifestation and absorption of drilling mud).

More than 100 specialists, representing party organizations of the city and oblast, oblast public organizations of NTO [scientific organization of labor], Mingeo RSFSR [RSFSR Ministry of Geology] and the following production associations: Orenburggazprom, Orenburgneft', Orenburggeologiya, Urengoyneftegazprom, Arkhangel'skgeologiya, Yeniseyneftegeologiya, Nizhnevolzhskgeologiya, Glavtyumengeologiya, Grozneft', Tomskneftegazgeologiya and academic, scientific research and planning-production institutes (UNI [Ufa Petroleum Institute], VNIIGAZ [All-Union Scientific Research Institute of Natural Gas] and ZapSibNIGNI [not further identified]), participated in its work.

It was noted at the conference that the periods of well construction have been reduced slightly during the past few years in new regions with complex geological conditions, despite the use of modern equipment, tools and drill bits. Moreover, a tendency toward an increase of expenditures on drilling test-prospecting wells was noted with regard to the fact that drilling operations are becoming more complicated each year. Drilling organizations are sometimes forced to struggle with geological complications unique in their parameters. This is primarily true of the thickness of productive deposits in fields of the Karachaganakskiy type and of the chemical aggressiveness of the gas of the Astrakhan gas condensate field.

The most suitable under current conditions for the Karachaganakskiy field is stepped overlapping of the gas mass by two and three casing strings. However, the problem is transformed to a large intersector scientific and technical problem, for solution of which the participation of both USSR Gosplan and GKNT [State Committee for Science and Technology] and of Mingazprom [Ministry of the Gas Industry], other ministries and departments is required, at final depths of wells of 5,000-6,000 meters and the presence of hydrogen sulfide and active saline tectonics with depth of submersion of salts up to 4,000 meters.

It has now become necessry to develop casing pipe and high-strength drilling pipe, resistant to hydrogen sulfide corrosion, 5,000 BD drilling rigs with block and tackle hoisting system up to 320 tons and also accelerated development of drilling rigs with lift up to 500 tons and to outfit the rigs with bases under the derrick unit not less than 6.5 meters high for location of the complex of antidischarge equipment. Drilling muds with density of 1.75 g/cm^3 and above, stable at high temperatures, hydrogen sulfide neutralizers in the drilling mud, personal protective equipment for workers, a gas suction system and system for utilization of it, corrosion-resistant antidischarge equipment and cements, resistant to hydrogen sulfide and carbon dioxide corrosion, must be developed.

There is as yet no experience in Soviet practice in operation of wells at fields with abnormally high hydrogen sulfide content, with installation of packers at depth of 4,000-5,500 meters with thickness of productive deposits of 1,500-1,700 meters, differing in porosity, permeability and having drilling mud absorption zones up to complete loss of circulation. Under these conditions, wells of complex design must be drilled to reveal the entire thickness of the productive bed.

One of the problems that require fundamental solution in drilling oil and gas wells more than 3,000 meters deep is to retain the prolonged stability of their shaft, since complications that lead to breakthroughs, cavern formation and sometimes even to accidents occur as depths increase. Moreover, there is overconsumption of materials and the reliability of geophysical data is reduced. The complexity of solving the given problem is explained by the fact that the mechanism of loss of shaft stability at depths greater than 3,000 meters has not been completely studied.

Problems of the stress-strain state of rock that make up the walls of the shaft and of the rock massif near it have not been adequately illuminated in the design documentation for construction of deep and superdeep wells. The estimate of the stress state of the rock, weakened by the well, must be refined from the viewpoint of the stability of the shaft walls, the effectiveness of collapse of the rock at the bottom and of discovery, testing and operation of productive collector beds. This requires the development of sufficiently complete and simple methods of calculating the existing stresses, which will make it possible to establish even during the design stage hazardous zones in the well.

The sector institutes of Minnefteprom are mainly involved in problems of isolation of absorption and the better known and more widely distributed type of complications. However, the effectiveness of work to eliminate absorptions has increased slightly over several decades, while the problem of controlling catastrophic absorption has not yet been fully resolved. A very typical complication for many regions is the manifestation of highly concentrated brine with yield up to 25,000 m^3/day from the salt dome with abnormally high pressure. Nevertheless, the proper attention is not being devoted to the problem of brine manifestation on the part of scientific organizations of Mingeo USSR and Mingasprom.

The main factor that determines the stability of the well shaft, enclosed with elastoplastic and elastoviscous rock, is their stress state, dependent primarily on the external effects on the rock massif, the pressure of the bed fluid and the physicomechanical properties of the rock under conditions of its deposition. The remaining factors (the fatigue of rock, osmosis, hydrodynamic pressures, the physicochemical effect of drilling mud and so on) have a secondary influence.

A zone of maximum equilibrium state with sufficient stability is formed during loading in a massif containing a well even at significant, but brief fluctuations of the loads with respect to external forces that cause this stable state of the shaft.

The results of investigations carried out by sector institutes, considered at the conference, are of specific interest for increasing the efficiency of drilling under complicated conditions. YuUO [not further identified] of VNIGNI proposed: 1) a method of calculating the stress-strain state of the shaft zone on the basis of the principles of the mechanics of solids, establishment on this basis of an estimate of the stress state of the elastoplastic massif, weakened by the vertical well (the solution is found on the basis of engineering analytical calculations with regard to the mechanical characteristics of rock and the elastoplastic state), 2) a complex of measures to prevent warping of the casing string in the thick mass of the rock salt and 3) a method of isolation of high-yield brine manifestations from the salt mass.

Volgo-UralNIPIgaz [Volga-Urals Scientific Research and Planning Institute of the Gas Industry] worked out: 1) special marks of plugging cement for fields containing hydrogen sulfide and 2) formulas and parameters of heavy, highly mineralized and inhibiting drilling mud, required for drilling unstable clay deposits of great thickness of the Ordovician Age and beds containing hydrogen sulfide.

IGIRNIGM [Institute of the Geology of and Prospecting for Oil and Gas Fields] proposed a method of predicting complicated geological conditions in salt domes and prevention of brine and gas manifestations in them during drilling.

BashNIPIneft' [Bashkir State Scientific Research and Planning Institute of the Petroleum Industry] and UNI [Ufa Petroleum Institute] investigated: 1) a method of artificial plugging of the porous space near the shaft by treating it with high-pressure jets of drilling mud that permits controlled silting of permeable rock with AVPD [not further identified] at different differential pressures in the well and 2) the hydrodynamic conditions for opening the beds and increasing its efficiency in the presence of different-pressure beds in the Orenburg gas condensate field.

VNIIKRneft' [not further identified] and VolgogradNIPIneft' considered: 1) the principles of stability of the well shaft in clay deposits and inhibition of drilling muds to prevent complications in the well and 2) a technique for drilling and testing wells under conditions of hydrogen sulfide and AVPD manifestation.

AzNIPIneft' and ZapSibNIGNI investigated the problem of optimizing the parameters of the production processes of drilling deep wells under conditions of AVPD.

SevKavNIPIneft' and TsNIL [Central Scientific Research Laboratory] of the association Orenburgneft' developed a method of finishing Soviet and licensed rolling cutter bits with regard to their design characteristics, operating dynamics and configuration of the bottom of the drilling tool.

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OIL WORKER ACHIEVEMENTS DURING 11TH FIVE-YEAR PLAN NOTED

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 5, May 84 pp 3-10

[Article by N. A. Mal'tsev, Ministry of the Petroleum Industry]

[Text] The year 1983 was an important benchmark in the building of communism for our country. The party's organizing work in solution of the tasks posed by the November (1982) and June (1983) Plenary sessions of the CPSU Central Committee and measures to strengthen state, planning and labor discipline yielded fruitful results. Confident forward movement in all directions of economic and social construction was provided. The volume of industrial production was increased by 4 percent compared to 2.9 percent in 1982. Production efficiency increased--labor productivity increased by 3.5 percent compared to the planned 2.9 percent. An 88 percent increase of products was achieved because of this.

Significant measures on a further rise of the people's welfare were implemented. The average annual wage of workers, kolkhoz workers and salaried employees increased and a bonus was added to retirement pensions for increased length of service and work at the same enterprise, institution or organization. National education and culture, medical service and organized recreation for workers achieved further development. More than 110 million m^3 of housing, many schools, preschool institutions, hospital, polyclinics and cultural-social facilities were introduced in 1983.

The decisions of the December (1983) Plenum of the CPSU Central Committee and of the Ninth Session of the USSR Supreme Soviet, 10th convocation, provided a new powerful impetus to the creative activity of the masses, having directed them toward achievement of new positions in the country's economic and social development. Important work remains in implementation of these decisions and it is important to utilize fully and more extensively the previously accumulated positive experience. The initiative of the country's leading collectives on overfulfillment of established tasks in labor productivity by 1 percent and a reduction of product cost by 0.5 percent, supported by the December (1983) Plenum of the CPSU Central Committee, should become an important position for workers of the petroleum industry as well.

At the same time, as pointed out at the Plenum, unconditional fulfillment of the plan should be provided, but all opportunities for overfulfillment of it

should be utilized. The continuity of the party's line to increase production efficiency, organization, business ability and discipline was emphasized with new force by the February (1984) special Plenum of the CPSU Central Committee.

The enterprises and organizations of Minnefteprom [Ministry of the Petroleum Industry] have achieved a further increase in the volume of oil and gas condensate production during the third year of the 11th Five-Year Plan. Whereas more than 616 million tons of oil and gas condensate were produced throughout the country as a whole in 1983, the fraction of Minnefteprom in this production was 596.3 million tons.

Good results were achieved in gas production as a result of important organizational and technical measures--the petroleum sector delivered more than 2.5 billion m^3 of gas above the plan to the national economy during three years of the 11th Five-Year Plan.

Western Siberia occupies a special position in the country's oil production. The main increase was achieved here during the past year, new oil fields were developed and new methods of well operation were introduced. Development of the country's main oil-producing base is a national matter. The production and engineering potential of other regions of the country, including that of most oil-producing regions, was recruited here.

An important result of 3 years of the 11th Five-Year Plan is a significant increase in the volume of drilling operations, essentially important as a basis for fulfillment of the five-year plan in oil production. Drilling operations in regions where the yield is highest from each drilled meter of oil wells was developed at especially high rates in 1981-1983. Thus, the volume of drilling operations increased 1.5-fold during this period at Glavtyumenneftegaz [Tyumen Main Administration of Oil and Gas], the increased 1.7- and 1.4-fold, respectively, at Associations Tomskneft' and Komineft' and 1.2-fold in Western Kazakhstan.

The industrial potential of the sector increased significantly during 3 years of the five-year plan. The most important basic funds--oil wells and capacities of GPZ [gas-processing plant]--were put into operation ahead of schedule. The volume of uncompleted construction decreased. The sector produced more than 100 million rubles' worth of products sold above the plan during 1983 alone. Plans on labor productivity were fulfilled and funds for operating needs were conserved.

An important link in achieving the high results is the selfless labor of the multithousand collective of workers of the petroleum industry. Much was also done by workers of related sectors that deliver equipment, hardware and materials to oil workers and that construct production facilities, housing and social and cultural-recreation facilities.

The contribution of the 12 leading collectives of the sector, which were awarded the challenge Red Banners of the CPSU Central Committee, USSR Council of Ministers, AUCCTU and All-Union Komsomol Central Committee for achieving the highest and most stable indicators in the All-Union socialist competition

and in fulfillment of the state plan for economic and social development of the USSR for 1983 and increased socialist pledges. Among these collectives are the associations Yuganskneftegaz, Ukrneft', Nizhnevolzhskneft', the Surgut UBR [Administration of Drilling Operations] No 2 of the association Surgut-neftegaz, the NGDU [Oil and Gas-Producing Administration] Arlanneft' of the association Bashneft', Bogatovskneft' of the association Kuybyshevneft', Kumdagneft' of the association Turkmenneft', Leninogorskneft' of the association Tatneft' and Rechitsaneft' of the association Belorusneft'. They were placed on the All-Union Honor Board at VDNKh SSSR [USSR Exhibition of Achievements of the National Economy].

If the main thing that success in the work of associations and enterprises provides is distinguished, then these are primarily support for the labor collectives of the oil- and gas-producing and drilling brigades, derrick-installation brigades and brigades for routine and major overhaul of wells and creation of conditions by them for highly productive labor.

The collective of the Surgut UBR No 2, which drilled more than 600,000 meters of wells in 1983 (the chief of the UBR is G. M. Levin), achieved outstanding results. This is an average of more than 100,000 meters for each brigade.

This indicator is undoubtedly an important position and reference mark for all drillers of Western Siberia. The main thing that has become the slogan of success is the meticulous organizing work to concentrate the forces of all collectives that participate in well construction on solution of the postulated tasks.

All managers and engineering and technical workers should work in this manner. People should be mobilized on a businesslike basis and conditions should be provided for them for highly efficient labor and fulfillment of planned tasks and adopted increased socialist pledges. It is no accident that the Komsomol-youth brigade of foreman V. L. Sidoreyko at this UBR drilled 117,000 meters of wells, which is a very high result.

The drilling brigades who are working by the watch-expeditionary method in Western Siberia, are increasing their rates of operations. The collectives of the brigades of foreman V. I. Tselibin and A. A. Martin of the association Saratovneftegaz and of T. M. Il'yasov and M. K. Timerkayev of the association Tatneft' achieved the greatest output during 1983.

The drilling brigades of foremen Yu. G. Gausknekht of the Izhevsk UBR of the association Udmurtneft', of V. F. Shinkin of the Aznakayevskiy UBR of the association Tatneft', of M. G. Drozdev of the Otradnyy UBR of the association Kuybyshevneft' and many others achieve high indicators from year to year.

The collectives of oil-producing shop No 1 (chief is M. M. Farrakhov) of the NGDU Mamontovneft' of the association Yuganskneftegaz, of the oil and gas-producing brigades of foremen G. G. Iskhakov aof NGDU Leninogorskneft' of association Tatneft' and of R. M. Galeyev of NGDU Chekmagushneft' of the association Bashneft' display standards of labor. There are many leading collectives and production shock workers in the sector and they exist in all oil regions of the country.

At the same time, it should be noted how the associations Nizhnevartovskneftegaz, Krasnoleninskneftegaz and Noyabr'skneftegaz of Glavtyumenneftegaz did not cope with the oil-production plan in 1983, although the level of production also increased here compared to 1982.

The state plan for the economic and social development of the USSR for 1984, confirmed by the 10th session of the USSR Supreme Soviet, 10th convocation, and which has acquired the force of law, posed crucial tasks to the workers of the petroleum industry.

Oil and gas condensate production throughout the country should reach 624 million tons, including more than 603 million tons throughout Minnefteprom. The greatest increases will be achieved in regions of Western Siberia, the Komi ASSR and Western Kazakhstan.

In 1984, sinking of wells should reach 28.3 million meters. Drilling operations will be developed at high rates at Glavtyumenneftegaz, where the increase should comprise more than two million meters. To achieve this is the task of many collectives of the sector that are participating in development of the Western Siberian Oil and Gas Complex.

More than 4,000 km of main oil and gas pipelines, including the Kholmogory-Klin oil pipeline, the Western Siberian--Urals-Volga area product pipeline, 24 oil pumping states, 1.8 million m^3 of depots, more than 11,000 km of oil field pipelines and many other facilities must be put into operation in 1984.

Very intensive, but quite realistic and fulfillable tasks have been posed to the oil workers; therefore, the causes of the deficiencies of 1983 should be thoroughly analyzed in each region and specific measures to correct them should be planned.

As noted above, last year three associations of Glavtyumenneftegaz did not cope with oil-production tasks. This is related specifically to the fact that there were extremely severe weather conditions in 1983 in regions of Western Siberia. However, the activity of all collectives in Western Siberia should not be a function of weather conditions. The prospects for development of each region, field and oil complex must be thoroughly thought out. There should be no time schemes in the solutions. One should clearly imagine that development of the Western Siberian region has entered a qualitatively new phase, which requires the adoption of multiple solutions that ensue from the need to provide production from wells by the mechanized method at high degree of recovery. New oil-producing centers must also be developed on this basis in uninhabited northern regions of Tyumen Oblast.

Strict monitoring of the operation of each well and of each facility of the enormous oil-field facility should be exercised. All this is related to an increase of the reliability of highways, electric power and pipeline systems and facilities for automation and telemechanization of production processes.

Work must primarily be carried out to strengthen the labor collectives in oil production--the brigades and shops for oil and gas production, routine repair

of wells and maintenance of bed pressure. It is the competent brigade that is the basis for success in fulfillment of the production program. The brigade is the keeper of the field and it coordinates the activities of many related subdivisions. Oil- and gas-producing brigades, depending on the number of wells to be serviced and local conditions, should be supplied with the neces- sary hardware. A brigade for routine repair of wells should be assigned to them, i.e., multiple brigades whose workers are combined with a general final goal and unified wage system to fulfill the established oil-producing task, should be created. The introduction of brigade cost-accounting should also be accelerated in them.

At the same time, the role and responsibility of oil- and gas-producing enter- prises should be increased by providing them with the hardware and correspond- ing bases. These enterprises should be responsible for developmetn of the entire oilfield complex, the reliability of the operating stock of wells, appropriate monitoring of the development of fields and solution of all social problems for their own worker collectives.

Extensive development of the gas lift method of well operation at the Samotlor and Fedorov fields is important in improving the use of the stock of wells. However, work to convert the wells to gas lift is still lagging.

The level of work on gas lift complexes must be increased, even more so since there is positive experience at the Pavdinsk field of the association Yuganskneftegaz.

The most effective use of the developed production and scientific and techni- cal potentials was named as the general direction for intensification of pro- duction at the December (1983) Plenum of the CPSU Central Committee. The use of the stock of wells must be improved in all regions. This is especially true of the associations Komineft', Embaneft' and Aktyubinskneft' of Glav- tyumenneftegaz. The production capacities of wells at the associations Perm- neft' and Turkmanneft' are not being fully utilized.

The task is that all wells should be put into operation. The fullest use of the stock of drilled wells, along with flooding, is a decisive direction for improvement of field exploitation.

Having achieved the fullest utilization of interior resources, one should also be constantly concerned about development of the raw material base of the sec- tor. However, the increase of oil reserves at the associations Yuganskneftе- gaz, Dagneft', Gruzneft' and Embaneft' has been lagging during the past few years.

The gas refiners are faced with serious tasks to improve the use of production funds and accordingly of the resources of wellhead gas. The VPO [All-Union Production Association] Soyuzneftegazpererabotka and the Production Associa- tion Sibneftegazpererabotka, together with collectives of the NGDU, must support the required load of gas refining plants in Western Siberia and must provide full use of the products produced at the plants. The problem of bringing in second and third separation stages in gas refining should be solved prior to introduction of the Western Siberian-Urals-Volga area product pipeline.

It is also important to utilize as fully as possible the capacities of the gas refining plants in old oil regions.

Measures for scientific and technical progress are core measures in fulfillment of the 1984 program. The decree "On measures to accelerate scientific and technical progress in the national economy," adopted by the CPSU Central Committee and the USSR Council of Ministers, is new evidence of the constant concern of the party and government about development of science and technology.

The petroleum industry is operating during the 11th Five-Year Plan under conditions when a large number of fields have entered the last stage of exploitation, characterized by a reduction in the level of oil production, by an increase of depletion and by increased corrosion activity of well products, by an increase of the specific weight of the mechanized method of operation and by the related increase of energy expenditures. More than half oil and gas condensate production is related to difficultly accessible and sparsely inhabited regions of Western Siberia, Kazakhstan and the European north of the USSR. Complex problems must be solved in development of the Zhanazhol and Tengiz fields in Western Kazakhstan.

Under these conditions, further development of the petroleum industry depends to an ever greater extent on intensification of oil production and accelerated introduction of the advances of science and technology. All these problems should be linked to that of environmental protection and rational use of natural resources.

The tasks of the sector in intensification of the influence of scientific and technical progress on achievement of the final results of its work, as follows from the decisions of the December (1983) and February (1984) Plenums of the CPSU Central Committee, reduce to the need for a significant increase of the growth rates of labor productivity, reduction of material consumption of production and development of energy-conserving technologies.

Extensive investigations are being conducted in implementation of the integrated program for increasing the oil yield of beds and chemization of production processes in the petroleum industry, which are of important national economic significance. Scientific production associations Soyuztermneft' and Soyuznefteproemkhim are obligated to increase the level of their work in these directions. There should be greater contact with our related ministries--Minkhimprom [Ministry of the Chemical Industry], USSR Minneftekhimprom [Ministry of the Petroleum Refining and Petrochemical Industry], Minudobreniy [Ministry of Mineral Fertilizer Production], Glavmikrobioprom [Main Administration of the Microbiological Industry], Minkhimmash [Ministry of Chemical and Petroleum Machine Building], Minelektrotekhprom [Ministry of the Electrical Equipment Industry] and so on.

Another important direction is implementation of the long-term program for technical re-equipping and improvement in organization of oil and gas drilling operations to significantly improve their technical and economic indicators.

There are considerable reserves for reducing non-productive time expenditures in construction of wells, since hardware is still not being efficiently utilized here and the level of production and technological maintenance lags behind current requirements. This is especially true of the drilling organizations of the associations Nizhnevartovskneftegaz, Tomskneft', Saratovneftegaz, Azneft' and so on. In total, the technical and economic indicators are lagging behind the tasks of the five-year plan both in exploitation and in test drilling.

The tasks to increase the technical level and the volumes of production of drilling equipment, tools and materials, in construction and introduction of hardware production capacities for construction of wells are not being completely fulfilled. Minkhimmash and Mintyazhmash [Ministry of Heavy Machine Building] should assist the oil workers in this.

Integrated automation of oil- and gas-producing enterprises is a very timely problem of scientific and technical progress to the sector. Successful solution of it will permit an increase in the level of labor productivity. However, work in this direction is lagging behind the intended plan. Whereas more than 90 percent of oil and gas condensate is produced from automated fields at the association's Bashneft', Tatneft', Udmurtneft' and Orenburgneft', production from automated fields of Glavtyumenneftegaz is still considerably less.

This situation is absolutely intolerable. Special attention should be devoted to labor-conserving measures in Western Siberia and they should be carried out vigorously and persistently.

An important direction of technical progress is reconstruction and modernization of existing facilities. These measures are directed primarily toward increasing the reliability and improving the use of main and field oil pipelines, the production facilities for oil production, electric supply and gas refining, especially in regions of Western Siberia.

Implementation of programs on technical progress in the sector should provide a decrease of labor expenditures in 1984 on maintenance of a single well to 1.41 persons, an increase of the commercial rate in exploitation drilling by 6 percent, an increase of the level of utilization of wellhead gas resources to 78.2 percent and a further increase of oil production due to new techniques that increase oil yield.

The attention of the collectives of enterprises, scientific research and planning institutes and design organizations and the entire management mechanism should be concentrated on achieving these positions in production efficiency.

The exceptional importance of capital construction in realization of the country's plans to increase industrial production was emphasized at the December (1983) Plenum of the CPSU Central Committee. The rates of development and improvement of production depend decisively on clear work of the builders. Advance introduction of basic funds by 3.2 percent in 1983 in the sector compared to 1982 compared to the growth rate of capital investments, which made it possible to provide a further decrease in the volume of uncompleted construction.

However, the state of affairs in capital construction cannot be regarded as satisfactory. The plan of construction and installation work in 1983 was fulfilled by only 87.6 percent. Basic funds worth 726 million rubles were not introduced. The fact that the volume of completed construction and installation work in 1983 was somewhat lower than in 1982 causes great alarm.

The administrations of Glavtransneft' and the associations Nizhnevartovskneftegaz, Komineft', Tomskneft', Aktyubinskneft', Soyuzneftegazpererabotka and Soyuzneftemashremont permitted the greatest lag. It is quite impermissible that our own construction organizations did not fulfill the plan in the sector.

There are specific complaints against the work of contract construction organizations at facilities of the petroleum industry. However, the main disadvantage should be seen in their work as client. Problems related to publication of technical documentation and complete sets of equipment were not alwasy solved in time. Serious omissions are being committed by clients in design, construction, acceptance of facilities for operation, as a result of which, for example, the reliability of field pipelines is at a low level.

A total of 8.7 billion rubles of capital investments, including 2.7 billion rubles of construction and installation work, must be assimilated in 1984. A further increase of the effectiveness of capital investments is provided in the plan and leading growth of introduction of basic funds is planned compared to the growth of capital investments, which should contribute to bringing the level of uncompleted construction up to standard.

Construction projects should be completely provided with missing technical documentation and complete sets of equipment and those responsible for starting complexes should be distinguished. Problems of interaction of related organizations should be regulated. A decisive factor of success is strengthening of planning discipline, increasing the personal responsibility of managers for timely introduction of each facility and fulfillment of tasks on re-equipping and renovation of production.

Problems of improving the planning system, of increasing the effectiveness of all economic levers and incentives of the economic mechanism, including pricing and methods of evaluating the results of economic activity, are related directly to strengthening of state, planning and production discipline. A program to improve planning, to create economic levers and incentives and to conduct economic experiments is being implemented in the petroleum industry. Thus, the system of incentives for the quality of oil preparation, introduced in 1983 in the sector, made it possible to increase the fraction of higher-grade oil produced by 20 percent compared to 1982.

At the same time, introduction of some economic incentives and improvement of planning of some types of work are being drawn out. Conversion of drilling organizations to a new planning and financing procedure and introduction of an incentives system for conservation of material expenditures were delayed.

The task of the sector is to contrast the complex of measures on conservation of material and labor expenditures, intensification of production and improvement of the use of production funds to deterioration of mining and geological conditions of field exploitation. A reduction of labor expenditures for production of goods and the volume of work acquires special significance under these conditions.

Glavtyumenneftegaz, production associations, enterprises and VNIIOENG [All-Union Scientific Research Institute for Organization, Management and Economy of the Petroleum and Gas Industry] must certify work stations within the shortest deadline and on the basis work out and implement measures on the best deployment of personnel and an increase of the efficiency of utilizing labor resources.

The core question is a thrifty attitude toward all resources which the sector distinguishes. It is important that, along with high requirements and responsibility of each worker to provide the strictest conservation conditions, that material- and energy-conserving techniques and technology and progressive standards of consumption of pipes, raw material and materials be actively worked out and extensively introduced.

Work to introduce cost accounting is of important significance. The line to intensify the influence of cost accounting at the enterprises of the sector should be sequentially carried out. This will increase the economic responsibility of the collective for the results of its own labor and will teach conservation of public property.

Exceptionally important attention was devoted to solution of social problems and to increasing the standard of living of the people at the December (1983) Plenum of the CPSU Central Committee and in the speech of General Secretary of the CPSU Central Committee Comrade K. U. Chernenko at the February and April (1984) Plenums of the CPSU Central Committee.

Housing and cultural-recreational construction is an important economic problem. In early 1983, the CPSU Central Committee adopted the decree "On measures to provide fulfillment of plans for construction of housing and social and recreational facilities." The CPSU Central Committee recognized as intolerable the non-fulfillment of plans for construction of non-productive facilities and required a fundamental change of attitude of all managers toward housing and civilian construction.

The situation with construction and introduction of non-production facilities improved appreciably in 1983 in the sector as a result of the adopted measures. Plans on introduction of hospitals, polyclinics, schools and kindergartens were fulfilled and overfulfilled. However, throughout the sector as a whole, the plan for introduction of housing was not fulfilled. Approximately 1.5 million m^2 of housing, including 900,000 m^2 in Western Siberia, must be introduced in 1984 and many day-care institutions, schools, polyclinics and hospitals and other cultural and recreational facilities must be constructed; therefore, the managers of associations and enterprises should constantly exercise control over the course of construction of housing and social-cultural facilities.

Despite some improvement of work in the field of labor protection and safety, there is concern about the status of affairs on prevention of accidents and injuries at the enterprises and in motor transport of the sector. Close attention of economic managers and trade-union organizations should be concentrated in solution of these problems.

Measures to implement the Provisions program occupy a central position in our plans. The enterprises and organizations of the sector are adopting measures in this direction and are organizing fulfillment of the corresponding measures of Minnefteprom and the central trade-union committees of the petroleum and gas industries. Approximately 30 new auxiliary farms were organized in 1983 alone. The volume of goods of the auxiliary farms and of the sovkhozes of the sector increased considerably. These products are a significant addition to the table of the families of workers of the petroleum industry.

At the same time, the sovkhozes of Glavtyumenneftegaz and of the associations Orenburgneft' and Tomskneft' and NPO [Scientific Production Association] Soyuztermneft' did not cope with fulfillment of the plans for production of basic types of agricultural products. Work in organization of new auxiliary farms was carried out unsatisfactorily at associations Stavropol'neftegaz, Saratovneftegaz, Nizhnevolzhskneft' and Krasnodarneftegaz.

In 1984, the net agricultural products will increase by 6 percent throughout the sector. This should be provided as a result of strengthening the material and technical base of the auxiliary farms and sovkhozes, of intensifying the use of lands and of creating new farms.

The socialist competition should have an enormous mobilizing effect on subsequent improvement of production and a creative approach to entrusted matters. The final results of the work of the collectives of enterprises and organizations depend largely on skills and initiative of economic managers and of social organizations to mobilize people. The collective of the association Yuganskneftegaz emerged in the sector with an initiative to organize a socialist competition for successful fulfillment and overfulfillment of the planned tasks for 1984. This patriotic initiative was approved by the board of directors of Minnefteprom and by the Presidium of the central trade-union committee of workers of the oil and gas industry and was supported in all the country's oil regions. The adopted socialist pledges will provide production of two million tons of oil and gas condensate above the plan and 200 million m^3 of gas above the plan throughout the sector in 1984.

The workers of the petroleum industry have adopted pledges to overfulfill plans by labor productivity by 1 percent and to reduce operating expenses by 0.5 percent.

The unfailing fulfillment of the planned tasks and conscientious and highly productive labor are not only the obligation but also the patriotic duty of every labor collective and of each worker under conditions of the sharply aggravated international situation through the fault of imperialistic circles.

The creative initiative of oil workers, supported by vigorous organizational work, is a guarantee of reliable success in development of the petroleum industry in 1984 and in fulfillment of the decisions of the 26th Party Congress and subsequent Plenums of the CPSU Central Committee.

6521
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IN-SITU COMBUSTION RECOVERY METHOD DISCUSSED, PROMOTED

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 5, May 84 pp 75-77

[Article by A. A. Sagindykov, candidate of chemical sciences: "Problems of In-Situ Combustion of Western Kazakhstan Petroleum"]

[Text] In the decisions of the 26th CPSU Congress, an increase in oil and gas condensate recovery levels of up to 620,000,000-645,000,000 tons was stipulated. It was also decided to enhance research-exploratory operations for oil extraction.

The problem of raising efficiency in the development of oil fields and the technology of oil recovery is a complicated task and its resolution on the proper scientific and technical level requires the attraction of significant forces and means. An integrated approach is also required.

In the USSR a substantial number of deposits containing high-viscosity oils have been located, and approximately half of them cannot be developed by traditional methods due to low effectiveness (where the coefficient of oil recovery does not exceed 0.15). The given reserves can be put into national-economic circulation for the most part by thermal methods, among which, according to expert evaluation, the most acceptable methods for industrial use are the steam heat stimulation and in-situ combustion. Use of the steam injection method entails the consumption of considerable amounts of raw materials (up to one-third of the recoverable oil) just to produce steam. In addition, the steam method of oil displacement is ineffective when developing deep-lying formations.

In contrast to the method of injecting hot water, which is produced on the surface, in-situ combustion is a thermal method of oil recovery in which the heat is generated right in the oil formation by burning a portion of the hydrocarbons; the process takes place autothermically. In-situ combustion occurs this way: air is forced into the formation, combustion is initiated and the process maintained. The quantity of energy discharged depends on the composition of the deposit oil; combustion of low-gravity oils gives off about 40 to 42 megajoules per kg.

At the present time there is reason to believe that in-situ may become one of the chief methods of increasing oil recovery levels from strata, since

during motion of the combustion front within the stratum an integrated elemental effect takes place, bringing about increased oil recovery: light hydrocarbons are formed which condense within the unheated zone of the stratum in advance of the combustion front, lowering the viscosity of the oil; the condensing moisture forms a zone of increased water saturation (an arch of hot water); thermal expansion of liquids and rocks occurs and permeability and porosity are increased as a result of the dissolution of the cementing materials; hydrocarbon gases and carbon dioxide formed during combustion are dissolved in water and petroleum, increasing their mobility; heavy petroleum fractions are subjected to pyrolysis and cracking, increasing the yield of hydrocarbonaceous raw materials from the stratum. The technological parameters of the in-situ process are improved as the pressure and temperature in the formation increase, favoring utilization of this method in developing relatively deep-lying formations. In addition, use of this method is not limited to formations containing high-viscosity oils, but can also be used in reservoirs containing low-density oil.

In spite of the fact that at the present time, as in the USSR, so also overseas, a large number of experimental and commercial tests of the in-situ method and varieties thereof (wet and super-wet in-situ) are being conducted, it should be noted that it is as yet not ready for wide commercial implementation in quantities characteristic of, say, the waterflood method. Moreover, it should be noted that assimilation of this method has been made difficult due to the necessity of creating conditions at the field which insure against the danger of explosion, and developing reliable methods of controlling the development of the process. It is considerably important that the oilfields be provided with reliable compressors and other equipment for this method to be used successfully. The difficulties mentioned are caused, in great measure, by poor prior study of the physical and chemical transmutations of hydrocarbon compounds, occurring in rocks under the effect of high temperatures and pressure.

In the chemical profile institutes of the AN [Academy of Sciences] KazSSR and the KazSSR Ministry of Higher and Secondary Education there are scientific premises which permit, through properly organized communication with Minnefteprom, both the necessary materials and equipment support to develop serious basic research into the problems in increasing oil recovery from strata and the chemization of the technological processes of oil recovery.

In the AN KazSSR Institute of the Chemistry of Petroleum and Natural Salts, they are carrying out systematic research into the physical and chemical properties of the oils of Kazakhstan and the influence of various factors on their rheology.

On the initiative, and under the leadership of AN KazSSR academician N. K. Nadirov, a series of basic scientific monographs, under the heading "The New Oils of Kazakhstan and Their Utilization" are being published by the institute and with the participation of petroleum and petrochemical industry specialists. The monographs have received a high rating by the scientific community. Thus, for example, the monographs "Oil Deposits of the Buzach Peninsula" formed the basis for the planning and construction of the unique

Kalamkas-Karazhanbas-Shevchenko oil pipeline, with an economic impact of over 37 million rubles. In 1980 this operation received the Kazakh SSR State Prize, and in 1983 the monograph "The Technology of Increasing Oil Recovery" won the I. M. Gubkin prize.

In the Kazakh "Order of Labor Red Banner" University imeni S. M. Kirov, the theoretical bases of the physics and chemistry of combustion in gaseous and condensate media were developed in order to solve the problems of in-situ combustion; the macrokinetics of processes in the combustion wave and the mechanism of the effect of various factors on the dynamics of the development and propagation of the combustion front. Research results on the chemism of the combustion of various fuels are summarized in Professor G. I. Ksandopulo's monograph "The Chemistry of Flame."

At Kazgosuniversitet [Kazakh State University] there are also highly qualified personnel in the area of the physicochemical processes of combustion, and specialists in chemical kinetics and combustion are published annually.

At the Kazakh imeni V. I. Lenin Polytechnical Institute, thermal methods of increasing oil recovery, relevant to Western Kazakh field conditions, are being studied in the Department of Physical and Analytical Chemistry and the Department of Oil and Gas Field Development and Exploitation.

Similar operations are being conducted in other oil-extracting regions of the country, where they, too, give special treatment to this problem, as long-range, in the solution of problems of increasing oil extraction.

To develop the resolutions of the joint meeting of the USSR Oil Industry Council of Ministers and the GKNT [USSR State Committee of the Council of Ministers for Science and Technology], the Scientific Council on Oil and Gas Problems and the AN USSR Department of General and Technical Chemistry on the problem "Status and Prospects of Operations for the Development and Incorporation of Chemical Products for Increasing Oil Extraction from Strata, and Chemization of the Technological Processes of Oil Extraction" (Kazan, 28-30 June 1983), and the resolutions of the conference with AN USSR President, Academician A. P. Aleksandrov (8 July 1983), and the resolutions of the conference with AN USSR Vice-President, Academician A. L. Yanshin (9 December 1983), the Presidium of the AN KazSSR and the Scientific Council on "Combustion Processes" along with the AN KazSSR Chemical and Technological Department conducted the All-Union Coordinated Conference and Seminar on in-situ combustion as one of the promising methods of increasing oil recovery from strata, on 27 January 1984.

Responsible workers of the KaSSR CP Central Committee and the KaSSR Council of Ministers, scientists of the AN USSR Department of General and Technical Chemistry, the AN USSR Institute of Chemical Physics, VNIINeft' [All-Union Science and Research Institute for Oil and Gas] KazGU imeni S. M. Kirov, [Kazakh State University], imeni V. I. Lenin Kazakh Polytechnical Institute, AN KazSSR imeni K. I. Satpayev Institute of Geological Sciences, KazNIPIneft' [Kazakh State Science, Research and Planning Institute for the Oil Industry] imeni I. M. Gubkin MINKHiGP [Moscow Order of Labor Red Banner Institute for

Oil Chemistry and Gas Industry imeni I. M. Gubkina], AN KazSSR Institute of the Chemistry of Petroleum and Natural Salts, AN KazSSR Institute of Chemical Sciences, and workers of oil recovery production associations participated in the conference.

N. M. Emanuel', academician-secretary of the AN USSR Department of General and Technical Chemistry, delivered a major and interesting report devoted to the problems of developing research in the chemical institutes of the AN USSR in the area of physical and chemical methods of raising oil recovery levels from strata, and the chemization of the technological processes of oil recovery.

In the report "Fundamentals of Oil Extraction Using In-Situ Combustion," A. A. Bokserman, doctor of technical sciences (VNIINeft'), presented a survey of the present-day status of the theory and practice of oil deposit development using the in-situ method and its variations (wet and super-wet in-situ).

Operations in progress in the AN KazSSR Institute of the Chemistry of Petroleum and Natural Salts, on the problems of raising oil recovery levels in Western Kazakh fields were reported on in a report by AN KazSSR academician N. K. Nadirov.

The report of K. Tuleshev, of Soyuztermneft' NPO, which was devoted to an analysis of the results of experimental and industrial tests of the in-situ method in the Karazhanbas field, aroused much interest.

Professor G. I. Ksandopulo, in his report "Chemical Structure of the Flame Front and Problems of Control by Combustion Processes," which was based on correlation of the results of operation conducted over a number of years in the imeni S. M. Kirov Kazakh State University Department of Chemical Kinetics and Combustion, proved that the effective and practical use of the processes which take place during combustion of hydrocarbonate fuels is possible only when based on knowledge of the chemical structure of the combustion front, means of affecting the chemism of combustion wave processes.

Problems of developing filters to combat sand intrusion while recovering oil by the heat-effect method were elucidated in a report by Professor Sh. A. Ershin, of imeni S. M. Kirov Kazakh State University.

The report of candidate of geological and mineralogical sciences M. M. Maylibayev, of the imeni V. I. Lenin Polytechnical Institute was devoted to the characteristics of the geological and physical conditions using in-situ combustion in the recovery of high-viscosity oils and bitumens.

Results of theoretical and experimental research into in-situ processes being conducted at the imeni I. M. Gubkin Institute of Petrochemical and Gas Industry, were introduced in a report by A. B. Zolotukhin and Ye. I. Korobkov.

In the resolutions of the conference and seminar it is being stressed that carrying out systematic research into physical and chemical conformance to principles of in-situ combustion can contribute both to determining the

nature of the causes of incomplete oil recovery, as well as to the development of methods for bed stimulation and eliminating the influence of these causes and, consequently, leading to an increase in oil recovery.

Selection of the most favorable methods of in-situ wet and super-wet burning is an exceedingly important task.

The solution to this problem is associated with the development of methods which permit:

--explosion-proof performance of the processes;

--limit the size of the burn area;

--raise pressure levels and maintain constant pressure in the formation;

--manage burning to produce greater gas-formation;

--displace oil from formations with reagents that are formed by in-situ gasification techniques;

--utilize the valuable by-products of gas combustion (ethylene, acetylene, propylene and sulphur dioxide);

--stimulate the combustion process in the formation with various additives;

--prevent large amounts of sand production in the well.

In order to convert the general theory of in-situ combustion into engineering practices through the process of calculation and management, what is needed is to attract more scientific potential from the ranks of the republic's researchers.

Considering the distribution of scientific subdivisions which has developed in Kazakhstan, the All-Union Coordinating Conference on In-Situ Combustion recommends, in its resolution, that an AN USSR and AN KazSSR facility be established in the city of Alma-Ata, with a scientific and research training facility in Mangyshlak.

The conference notes that the long-range development of research in the physicochemistry of in-situ combustion in Kazakhstan is also conducive to the presence of highly-trained specialists in a number of related areas (geophysics, oil and gas field development, equipment and technology of well-drilling, physical and chemical hydrodynamics, and the chemistry of water-soluble polymers.

The conference has come to the decision that it is advisable to establish a special purpose integrated regional program for the Kazakh SSR: "The Development of Scientific Bases and Methods of Optimization, and Broad Incorporation of In-Situ Combustion in Western Kazakh Oil Fields to Raise Oil Recovery Levels from Strata."

12659
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KARACHAGANAK FIELD BEGINS DEVELOPMENT

Moscow PRAVDA in Russian 17 Jul 84 p 1

[Article by G. Sazonov, PRAVDA correspondent, Orenburg-Ural oblasts: "Drill-sites Stride Into the Steppe: Theory and Practice of Carrying Out [Socialist] Obligations"]

> [Text] Karachaganak. One hears the name of this small Ural village in the Kazakh steppe more and more often in the conversations of Orenburg's gas workers. Gas and condensate reserves have been discovered near here. The Karachaganak field facilities have visibly begun to develop. The construction crews, who come from the collectives of Minneftegazstroy and Mingazprom sub-divisions, have taken it upon themselves to put into operation, the experimental and commercial field facilities ahead of schedule.

The shadow of the MI-8 helicopter, on its way to Karachaganak, glided quickly along the mirror-like surface of the Ural River and the carpet of woods and fields of the flood-plain. About an hour has passed, and through the window I have caught sight of the sandy steppe rushing toward us along with rows of multicolored boxcars and several drilling rigs.

"This is the heart of the field," noted I. Kurmygin, Orenburggazstroy Trust director, as we arrived at the construction area of the installation handling general raw-material preparation. "Gas and condensate from the wells will be coming here in October."

An installation is an entire complex of structures. The raw material will go from the huge storage tanks to the gas refinery at Orenburg. At the beginning of the year construction workers fell behind schedule, but have since made up for the lag. What made the difference was the skill of the brigades, who knew how to build equipment foundations under challenging weather conditions. Every day, a great many of them exceed output quotas.

"We made up our minds to finish our projects at the installation a month ahead of deadline," reported V. Volkov, leader of an integrated brigade. "The potential is here."

Construction work is no simple task out on the open steppe, far from human habitation. There is heat, and frequent dust storms. Still, the majority

of collectives labor like shock-workers. I. Ivanov's crew keeps up an uninterrupted supply of concrete to the construction area from the concrete and mortar terminal, and the work on the compressor building and other projects is going along quite well.

There is also a great deal of equipment still to be set up. This has been entrusted to the Vostokmontazhgaz Trust Collective from Almetyev, which is still shaping up rather poorly. The construction workers think that the installers' work ought to be better organized, and that they should be given needed machinery. The same might be said for the installation collective working on chemical safety. Geologists of the Ural oil exploration expedition discovered the Karachaganak deposits in the autumn of 1979. Having found that the gas had a high content of hydrogen sulfide, they got in touch with Orenburggazprom Association, which has substantial experience dealing with similar raw materials.

"The Karachaganak field is comparable in value to the Orenburg gas condensate field," says V. Alekseyev, chief gas industry administration geologist. But there are differences. In particular, there's the higher sulfur content, and there are paraffins, both valuable raw materials for various branches of industry. The geologists' task is to make a geological model of the new field. This will help the field developers work out methods of raw material recovery.

The future developers have acted prudently. They set up a research unit at the very first well put into operation. Using instruments, the operators and engineers of the local administration, along with co-workers from two scientific and research institutes, are studying the special features of the gas and condensate to decide on a recovery procedure.

And the drillsites stride still farther into the steppe. The collectives of the Ural oil exploration expedition and the Karachaganak drilling operations administration have to turn over 14 wells to the developers for a combined startup. Development of the field must be accelerated.

Once again the MI-8 gained altitude. The helicopter will fly above and along the right-of-way from the field to Orenburg. Here are the three pipelines along which the raw materials will travel to the gas refinery. So far, the construction workers here are behind schedule.

The Orenburggazzavod associations are rebuilding the third phase of the refinery to receive and refine the Karachaganak raw materials. Last year, the Orenburgenergostroy administration failed to meet the reconstruction deadline, but at present they are slowly catching up. In a word, the construction collectives need to coordinate their operations better.

And one more thing. Without doubt, development of a new field will give new life to the city of Aksay, the rayon center in Ural Oblast. For now, housing and socio-cultural facilities are being built slowly.

The great flare, which has blazed at the first well, seems to symbolize the mighty power held captive in the depths of the earth. Subjecting this power to the will of man is not one of the easier tasks. Today's construction is only the beginning of a great effort.

12659
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NEW EQUIPMENT INCREASES TURKMEN GAS OUTPUT

Ashkhabad TURKMENSKAYA ISKRA in Russian 8 Jul 84 p 1

[Article by S. Petrosyan, Turkmenneftegazstroy Association department head: "The Gas River Is Filling Up"]

[Text] A day or two ago another influx of Turkmen blue fuel reached the Central Asia--Tsentr main gas pipeline. The new facility for preliminary gas processing began operation at the Sovetabad Field, the largest formation in the republic. Start-up of the UPPG-8 [preliminary gas processing facility No 8] means the capacity of the Kara Kum field has been increased two-fold.

Construction of area surface facilities continues. During the second half of July, the Shatlykgazstroy Trust collective is slated to begin installation of the next facility, UPPG-2, located 24 kilometers from GS-1 operating pilot plants. They are already putting in a road and a gas collector here. As soon as the road is laid out with gravel the customer, Shatlykgazdobycha Association, will begin delivering large-module equipment to the project.

The UPPG-2 start-up is for 1985, going by the standard construction schedule. But allied component manufacturers intend to put it into operation by this December. This summer the construction workers will complete their primary assignments in the area: the second set of principal structures.

Work on the surface facilities at the Seyrab Field continues apace. The Naipgazstroy Trust must still spend 2.5 million rubles here. Equipment needs to be set up, lines and pipelines need to be connected and tested, and gas wells need to be tied in. In August the UPPG-Seyrab must feed gas to the Uchadzhi installation, where the gas will be processed for long-distance transport to the center of the country.

Ready for start-up are facilities for the recovery of nonsulfurous gas in Northern Balkui. The State Acceptance Commission works here. The Naipgazstroy Trust collective's task is to turn over high-quality units. Winners have been designated among Turkmenistan's gas construction workers in the socialist competition. According to the totals for the first 6 months of the year, they are the brigade of N. Pololin of Naipgazstroy, and the brigades of Yu. Aksalov, E. Alimetov and A. Dilya of Shatlykgazstroy.

Thanks to the shock-work of these gas recovery enterprise producers out in the desert, the republic's fuel industry is taking a great step forward toward increasing capacity and strengthening the country's economic potential.

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GENERAL

MINERGOMASH MINISTER OUTLINES ENERGY PROGRAM

Moscow EKONOMICHESKAYA GAZETA in Russian No 23, Jun 84 p 2

[Article by USSR Minister of Power Machine Construction V. M. Velichko: "Machine Construction for the Energy Program"]

[Text] The power machine developers--the chief suppliers of equipment for practically all types of power station, as well as the compressor stations of gas mains and oilfield steam-generator sets--are confronted with both presentday and future tasks posed by the Energy Program of the USSR.

Expansion of the basic atomic power stations, atomic thermoelectric centrals, and atomic heating stations is founded on the major advances of Soviet science and technology.

Quite recently the power block of the AES with the "million" [kW] reactor was considered the last word in Soviet nuclear engineering. Now even this has been outstripped. Design, production and installation of equipment of the main block of the Ignalinskaya AES, having a reactor of unit power 1.5 million kW, have been completed. The three mentioned stages--design, production, installation--are not just arbitrary words. Actually, each is a complex, critical, labor-intense and lengthy process. Each must guarantee the quality of Soviet nuclear power plants: reliable and stable operation, environmental safety.

As we know, a USSR state committee was established to supervise work safety in atomic power engineering.

Up to 30 percent of all labor costs at enterprises producing AES equipment is taken up by inspections, making broad use of diversified nondestructive measuring instruments: from ultrasound and color defectoscopy to x-rays and linear accelerators. Little more than a decade ago such technology was basically a tool of the research laboratory. Now it has crossed the threshold of the industrial workshop and has taken its place in the work program, alongside high-efficiency machine tools and special-purpose "processing centers."

In 1984 the work program of the Izhorsk Factory Production Association imeni Zhdanov was greatly intensified. Improved blanks were adopted for the vessel equipment of the AES. This will greatly cut down on the number of welds.

The Krasnyy Kotel'shchik Production Association imeni 60th Anniversary of the USSR and the Podolsk Machine Construction Factory imeni Ordzhonikidze are finishing up the conversion to a manufacture of more efficient AES heat exchange and steam generating equipment. For example, the Krasnyy Kotel'shchik Association has actually begun production of so-called "coiled" heat exchangers. A single enlarged plant will replace around 20 individual heat exchangers in the production program of AES and TES.

As for the development of turbines for nuclear power plants, the machinists have acquired a great deal of experience in this field in the design and organization of production of models with unit power of 500, 750 and 1,000 MW. Already concerned about the future, Kharkov and Leningrad turbine developers are working out designs for low-speed and high-speed AES million-capacity turbines with upgraded technical-economic indicators. A special central heating turbine is to be created for the Odessa ATETs [nuclear thermal electric power plant]. Its unit power will be twice as large as the now-common 250-kW turbine T-250 used by the TETs.

Furthermore, feasibility studies are continuing on the use of low-speed turbo-units of 1 million kW unit power with two low-pressure cylinders at AES power blocks with VVER-1000 [water-cooled] reactors. Cutting down on the number of low-pressure cylinders without loss of electric power promises a substantial savings of metal, a net reduction of labor costs at the factory and during installation, a shortening of the production cycle and, consequently, an excellent final product.

The future flagship of the industry--the Atommash Association of Volgodonsk--is still being built and adding on power facilities. Effective measures have been adopted here to correct the shortcomings that were found.

The energy program envisions a reorientation of Soviet thermal engineering to the combustion of low-grade fuel types, including the coals of KATEK and Ekibastuz, and the use of associated gas of the West Siberian oilfields for production of electricity.

All this necessitated that the power machine developers concentrate their creative potential on the design and production of new equipment for conventional TES and TETs, whose share of the overall volume of electricity generation is still more than two-thirds.

Many domestic designs of efficient basic and accessory power equipment have been proposed for practical adoption in thermal engineering. Such are the large straight-flow boiler units for power blocks of unit power 300, 500 and 800 MW with supercritical steam parameters.

It is characteristic that all large boilers at present are being made with gas-tight heating surfaces, which raises the efficiency by 1.5 percent and allows a considerable savings of fuel at the power stations. The series of standardized gas-tight boilers with a capacity of 420 tons steam per hour, developed by the Sibenergomash Production Association, was awarded the Prize of the USSR Council of Ministers in 1983.

Recently the first equipment was delivered to the Permskaya GRES and the Berezovskaya GRES-1 for monoblocks of 800 MW unit power whose furnaces will burn solid fuel. Huge boilers of 2.650 tons steam per hour capacity apiece will begin to use Kuznetsk hard coal and Kansk-Achinsk brown coals. The changing quality of the coal from different deposits or individual strata has been taken into account.

Mass production of so-called low-capacity boilers (1-25 tons steam per hour) has been organized for a broad range of users, including the BAM and industrial power plants, and to meet the various production and in-house needs of small facilities.

Just like other machinery, power units at electric plants are not eternal. The time has come to replace several models of unit power 50, 100, 160, 200 and 300 MW that have already exhausted their maximum lifetime or are about to. In our opinion, it is advisable to implement this by developing specialized 200 and 300 MW blocks.

At the same time, it is possible to employ turbines with combined high and medium-pressure cylinders when renovating the equipment of power blocks of 200 and 300 MW unit power. Thus, the old production space of the TES can be utilized, cutting down on capital investments for the re-outfitting of these power stations.

Current Soviet hydroturbine construction occupies a leading position in the world. Soviet hydroturbines often surpass the best models in their technical-economic parameters: unit power, specific metal, volume, speed of operation, efficiency.

With the start of the 11th Five-Year Plan, the Shamkhor, Kurpsaysk, Dneprovsk, Vartsikhsk and Tuya-Muyunsk GES have been fitted out with high-efficiency hydroturbines. The Leningrad Metal Plant Production Association has completed delivery of hydroturbine rotors with 640,000 kW unit power for the Sayano-Shushenskaya GES. Delivery of hydraulic turbogenerator units for the Nizhnekamsk, Mayna, Kolyma and other hydroelectric stations is scheduled to be completed before the end of the current 5-year period.

In carrying out the tasks of the Energy Program, the power machine developers have now begun to prepare for production of scoop hydroturbines of 175 MW unit power, to be installed at the Zaramagskaya GES, and radial-axial turbines of 153 MW power apiece for the Kureyskaya GES. A project sketch has been developed for a 340 MW radial-axial turbine for the Boguchanskaya GES.

Pivoting-vane hydroturbines with 230 MW unit power, produced for the Shul'binskaya GES, are the largest in the world. Experts consider it possible to surpass even these. Studies have already been organized for the purpose of developing such models of 400-450 MW unit power, which will greatly raise the efficiency of the GES.

In 1986-1990 the enterprises of the Minergomash will take direct part in outfitting a number of GES and GAES, [pumped water storage power plants]

about two-thirds of which will be built for the first time. Design and production teams are already preparing the groundwork for this task.

At the start of the 4th year of the 5-year period, the work teams of all our enterprises reviewed their capabilities, after deciding on an additional 1 percent increase in labor productivity and a 0.5 percent cut in net costs beyond the scheduled level of decrease.

To meet these responsibilities, they have begun to exploit more fully their in-house reserves and production facilities. Raw materials, various items, and fuel are being economized. The power machine developers hope to exceed the production program with a smaller work force. Much attention will be given to raising the shift coefficient of the production equipment, especially individualized types.

The outcome of the first 4 months shows that the enterprises of the Minergomash have stiffened the labor and plan discipline. Compared to the same period of last year the labor productivity has risen by 10.5 percent, as opposed to the planned 7.1. Net costs of production have dropped, as had been mandated. The planned assortment and contract stipulations have not been entirely met. Obviously, some slack exists.

For the purpose of successful achievement of scheduled tasks for 1984, as well as implementation of the energy program, the industry continues to upgrade the material resources, especially in-house metallurgical production. At all the enterprises the replacement of steel casting and forging by progressive welded and welded-forged designs is actively underway.

Start-up of AES Capacities
by 5-Year Periods (Millions of kW)

We now realize that the full range of problems of the industry is not yet fully solved. So-called bottlenecks have not been completely identified and corrected. For example, a well-organized instrument production facility in each enterprise is not only a prerequisite for high-quality products, but also a critical means of boosting labor productivity. However, proper attention is not always paid to this important asset and to the technical re-equipment using modern automation. That is why we intend in the near future to take decisive action in the matter of instrumentation.

The total automation of equipment will allow to cut further electricity production costs and raise plant efficiency. This is a sure means of solving the problem brought up by Comrade K. U. Chernenko at a meeting with workers of the Serp i molot Metallurgical Factory of Moscow: "...we cannot tolerate the fact that many standard engines and boilers at power stations burn 15-20 percent more fuel than the best models created by Soviet scientists and designers."

The energy program of the country is quite broad. Its implementation will involve much work by all connected with it. But there is no doubt that each goal will be reached.

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GENERAL

CAPITAL INVESTMENT IN FUEL INDUSTRY SECTORS

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 6, Jun 84 pp 25-34

[Article by Candidate of Economic Sciences K. Maksimov, sector head of VNIIKTEP attached to USSR Gosplan]

[Text] The indicators of the effectiveness of capital investments occupy a special place in planning the national economy, since they serve as quantitative characteristics by which the versions of development of sectors and of individual facilities are compared and selected and by which questions of fund distribution are solved.* A standard method of determining the effectiveness of capital investments is now operational. However, specific characteristics, not always completely taken into account by this method, are inherent to fuel sectors. Moreover, not all the problems and intersector procedure have been solved in it, while some positions require development and improvement, which is indicated by the recent debate of economists on this problem.**

Let us analyze some problems of the theory and methodology of determining the indices of effectiveness and the role of the latter in evaluation, comparison and selection of the versions of development of fuel sectors.

The Specific Cost of Capacities

Analysis of the methods of calculating the UKV [specific capital investments] in fuel sectors permits one to determine two types of indicators. The first is determined by the ratio of capital investments to capacity and the second is determined by the ratio of capital investments to fuel production within a specific period.

Capacity sometimes varies within specific limits in the first of them: total annual (old plus new), annual, introduced at new and renovated facilities (new capacity), in the oil and gas industry--the capacity of new wells during the total period of their operation, the annual capacity of a field--the average for

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*In the form of a postulation.

**See the articles of Academician T. S. Khachaturov, Academician N. P. Fedorenko, N. P. Glushkov, V. P. Krasovskiy, B. S. Vaynshteyn et al. in the journals: VOPROSY EKONOMIKI, No. 3, No. 11, 1983; No. 1, 1984; EKONOMIKA I MATEMATICHESKIYE METODY, Vol. 9, No. 6, 1983.

the main or entire period of exploitation, the annual increase of capacity (input minus outgo per year) and increase during the five-year plan.

Capital investments are also understood as different in composition, for example, for only new facilities of main activity; the same, but with inclusion of expenditures for renovation, all types of investments in production facilities, including those for renovation of basic funds that do not increase their cost, expenditures on facilities of main activity and of the production infrastructure of a fuel-producing region, the same, but with inclusion of funds for nonproduction infrastructure, investments in production and nonproduction facilities and also in development of integrated sectors that deliver equipment and materials to fuel sectors.

In the second type of specific capital investments, where they vary in composition and length of periods and where the volume of production is only by periods, the common factor is that the index is calculated per ton of produced fuel (during the entire or main period of exploitation, year or five-year plan) rather than per unit capacity.

This abundance of versions of specific capital investments makes it difficult to obtain comparable indicators. The economic essence of these two types of specific capital investments can be determined to facilitate the problem.

The index of specific capital investments of the first type is the specific cost of production capacities and usually has the dimensionality of rubles/units/year (rubles/tons/year, rubles/kW·hr/year). With regard to the second type, we feel that the indicator determined as the ratio of the total sum of capital investments in exploitation of a field (pool) to the total volume of fuel production during the period of producing the reserves, is more correct. This index reflects the average expenditures of the labor resources consumed per unit of extracted fuel reserves. In other words, it is different than the average sum of depreciation (during exploitation), which should be included in the cost of the unit of fuel. Unlike the specific cost of capacities, the given indicator is related to the unit product rather than to the unit of annual capacity and has the dimension of rubles/ton rather than rubles/ton/year. These indicators cannot be mixed and substituted one for another, which is frequently permitted. To avoid this, specific capital investments per unit of annual capacity should be called the specific cost of capacities.

When calculating the specific cost of capacities, it is logical to relate the volume of capital investments only to the capacity which is created by a given volume of investments. This principle is frequently violated, which also causes incompatibility of specific capital investments of the first type.

For example, in calculations at macrolevels, capital investments during the planning period (year, five-year plan) are related to capacities introduced during the same period. This "readdressing" of capital investments eliminates specific indicators and even more so, the longer the cycle of construction of facilities in the sector and the more irregularly the volumes of investments and input of capacities are distributed by years. Another cause of incompatibility is related to the part of renovation investments, which is directed toward replacement of outgoing funds without an increase of their cost and capacity.

In view of the differences in designation and economic nature, capital investments for new construction and for renovation of funds, we feel, cannot be mixed. They should obviously be taken into account and planned separately, depending on the nature of the problems to be solved and with regard to the characteristics of sectors. Specifically, at least three reproduction types of capital investments: for simple reproduction of basic funds, for compensation of a natural reduction of the productivity of existing facilities (these investments are not renovation investments since they create new, supplementary funds and capacities) and for an increase of capacities (volumes of production) throughout the sector--can be distinguished in producing sectors during planning.

It is obvious that the total need for capital investments is determined as the sum of the three given items. However, this total is divided irregularly by one or another capacity, since renovation investments do not create capacities and therefore cannot participate in determination of their cost.

The specific cost of capacities can be determined only from newly entered (planned) capacities and only by dividing the total capital investments in production funds of a facility (during the construction or renovation cycle) by the new capacity created by it. This method of calculating the specific capital investments for fuel sectors is provided by the Provisional Instructions on Determination of the Comparative Economy of Production and Transport of Interchangeable Types of Fuel (1963). This method is used in power engineering, petroleum and gas refining and also in the coal industry. Deviation from it in the other fuel sectors causes intersector incompatability of the indicators of the specific cost of capacities. It would seem that this single solution should be sufficiently repeated in existing intersector methods to eliminate it. But, as practice shows, this is hardly done since calculations are carried out for the volumes of capital investments, whereas the effective cost of production capacities is fixed in the cost of production funds.

It was justifiably noted in publications on the given topic that determination of specific capital investments according to the instructions yields an indicator close to that of the specific cost of the funds per unit capacity.* And this is no accident, since the cost of funds should be equal in the ideal version to the volume of capital investments expended for creation of them. Accordingly, specific capital investments per unit capacity and the specific fund of capacities would be the same indicator--the specific cost of capacities, except the first would be for newly constructed enterprises and the second would be for existing enterprises.

But the cost of funds is usually somewhat less than the capital investments to create them. The coefficient of the capital capacity of funds (it is equal to the ratio of initial capital investments to develop a facility to the initial cost of its production funds) has been introduced into practice in some sectors (for example, in power engineering) to account for this difference. It should be used in all sectors. Then each sector and each fuel-producing rayon would

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*See V. Filanovskiy and V. Bugrov, "Improving the Method of Determining Specific Capital Investments in the Fuel-Producing Industry," PLANOVOYE KHOZYAYSTVO, No. 10, 1981.

have its own mean values of the coefficient, which would become the norms for recalculation of the volumes of capital investment in the cost of funds and vice versa.

Thus, we are talking about intersector comparisons of old and new capacities according to the indicator of their specific fund capacity in evaluating drafts of investments, while the difference between capital investments and the cost of funds should be evaluated and fixed in the form of the coefficient of the capital capacity of the latter. The problem of reflecting all subsequent capital investments in specific indicators is easily solved with this method of estimation of capacities, since the variations of the cost of funds and of the production capacity of enterprises, which occur upon replacement of outgoing funds and modification and reconstruction of them, will be completely reflected in the indicator of the specific fund capacity and in its dynamics.

Estimation of capacities by the indicator of their specific fund capacity eliminates the main causes of incompatability of the specific cost of capacities and prevents relation of capital investments to those capacities which are not created by them. The comparative indicators of the specific fund capacity of new and existing capacities in fuel sectors are presented in Table 1 (in percent of the fund capacity for gas production in 1970 per ton/year of comparison fuel).

The problem of comparability does not arise in determination of fund capacity. The indicators for new capacities and existing capacities are similar in value, but their differences are explained by regional structure. However, these indicators still cannot be used for intersector comparisons, since the specific cost of capacities is not taken into account even in calculation for comparison fuel: the differences of the consumption properties of coal, oil and gas both as a fuel and as raw material for refinement, the differences in labor productivity and material capacity during production, transport and use of them, differences of the periods of construction, assimilation of capacities and service of funds, i.e., the effect of time factors, and the reliability of the fuel supply. Therefore, the role of the indicator of the specific cost of capacities should be limited by intersector comparisons, all things being equal.

Table 1

Industry	Capacity	1970	1975	1980
Gas*	old	100/500	155/840	275/1090
	new	165/455	130/505	225/955
Oil	old	305	395	480
	new	280	290	495
Coal	old	580	655	700
	new	480	635	755

* Gas production is reflected in the numerator and production and major transportation is shown in the denominator.

Reduced Expenditures for Product Output

A more capacious indicator than specific capital investments are reduced expenditures. However, the method of determining them for fuel remains a subject of acute debate. There are arguments both about the essence and value of the norm E_n and about the composition of K. Some economists feel that determination of reduced expenditures in the fuel sectors encounters insurmountable methodical difficulties, since there is no single answer to the question of which specific capital investments must be taken as a basis.* The problems of determining the specific capital investments is thus transferred to the region of reduced expenditures.

Let us attempt in this regard to refine the economic essence of component E_nK so as to facilitate the search for the corrected method of calculating it.

The economic essence of the product E_nK is not revealed in all three editions of the method for determination of the effectiveness of capital investments (1960, 1969 and 1980). It is pointed out that the standard of effectiveness determines the necessary boundary of conservation of current labor expenditures for product output, i.e., of a reduction of cost by using means of labor with cost "K." But it is known that a reduction of cost in sale of a product is transformed to an increase of profit. This means that an increase of E_nK is normal profit. It follows from this that the norm of effectiveness means minimum annual norm of profit in fractions of the estimated cost of the means of production used. For example, if $E_n = 0.12$ and $K = 2$ million rubles, then the annual mass profit will comprise no less than 0.24 million rubles/year, i.e., not less than 12 percent of the annual cost of all the means of production used. Two significant details are important here. The word "12 percent annually" indicates the "divisibility" of the norm of effectiveness and that it can be "broken down" with respect to shorter time segments, up to the time of producing a unit product. A norm of the type "n percent annually" can be reduced to the form n/12 percent per month, n/365 percent per day and up to n/d percent per unit product.

The second part of the formulation--"of the cost of all means used"--indicates that the capital cost used in these calculations is a "indivisible" value, since the estimated cost of an enterprise remains the target value regardless of whether its operation is considered for the year, month or hour. This means that, to determine the specific profit per unit product, the component E_nK in the formula of specific reduced expenditures must be considered in the following manner:

$$\frac{E_n/\text{year}}{\text{Production for one year}} K_{cm} \left(\text{instead of } E_n \frac{K_{cm}}{\text{Capacity}}\right)$$

Let us prove this by an example. Let us assume that the estimated cost of a fuel enterprise is equal to 1 million tons/year, but the estimated cost of preliminary investments in it is 20 million rubles, that the fuel production

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*See EKONOMIKA NEFTYANOY PROMYSHLENNOSTI, No. 2, 1981.

during the year under consideration is 900,000 tons, that the operating expenses during the same period is 10 million rubles, that the fuel reserves extracted are 50 million tons, that the planned period of extraction of reserves is 50 years, that the total volume of capital investments during the period of exploitation is 45 million rubles and that the coefficient of the capital capacity of funds is 1.

One can solve the following problems from these data. The first is calculation of the specific cost of unit of annual capacity, i.e.,

Specific capital investments [UKV-1]= 20 million rubles divided by 1 million t/annum = 20 rubles/t/year.

The second problem is to determine the specific reduced expenditures per unit of fuel during the year under consideration. To do this, the standard of effectiveness per ton must be calculated:

$$(E_{n\ u} = 0.12 \frac{1}{\text{year}} \text{ div. by } 900{,}000 \text{ t/year} = 0.000000133 \text{ t})$$

having multiplied it by the estimated cost of construction, one must determine the specific normal profit per ton of fuel:

$$(P_u = 0.000000133 \frac{1}{t} \times 20 \text{ million rubles} = 2.67 \text{ rubles/t}).$$

having added to it the cost of 1 ton of fuel (C_u = 11.11 rubles/ton), determined the specific adduced expenditures [Zp]:

$$Zp = Cu + Pu = 11.11 + 2.67 = 13.78 \text{ rubles/t}.$$

This example shows that the specific capital investments do not participate either per unit of capacity (10 rubles·tons/year) or per unit product (0.9 rubles/ton) in strict calculation of the specific reduced expenditures. Moreover, the specific normal profit (per unit product), equal to the ratio of the annual norm E_n to the annual volume of product, and the total cost of the means of production used at the enterprise are employed.

Many economists mix and combine two different problems, considered in the example, in an attempt to determine reduced expenditures per unit product by adding the cost of a unit of product and the cost of a unit of annual capacity, multiplied by E_n. It is not taken into account in this case that the added indices differ not only by dimensionality but also by the fact that current expenditures are related to the product, while capital investments are related to the means of its production; therefore, they cannot be added. The following conclusion ensues from the foregoing: to overcome the incompatability of the indicators of reduced expenditures, which occurs due to component E_nK, one must first clearly distinguish these problems and one must use specific capital investments when solving the second of them. Specific reduced expenditures per

unit of fuel can be calculated either as shown in the example or (which is more convenient) the annual reduced expenditures for the facility are initially determined and they are then divided by the annual production of fuel. When determining the average reduced expenditures for the five-year plan, they should be calculated as average weighted expenditures from the annual expenditures.

Moreover, the time is ripe to refine the formula of reduced expenditures. The first refinement concerns reduced expenditures on the production of operating enterprises. For then, the value of K in the formula can be determined by multiplication of the recovery cost of production funds of the fuel enterprise (F_{pr}) by the rayon coefficient of the capital capacity of funds: ($K = F_{pr} \cdot K_{ef}$), which permits one to take into account capital investments not included in the cost of the production funds of operating enterprises.

The second refinement concerns the content of the norm of effectiveness. The norm of profit emerges as this refinement. But the total effect of production is national income in socialism and net production is the total effect at the level of enterprises and ministries. The innacuracy of the norm of effectiveness to be used was noted by Academician T. S. Khachaturov.*

Calculations show that the value of social expenditures of labor for production and transport of fuel is reduced when the norms of effectiveness are used in the form of the minimum norm of profit due to reduction of cost. Nevertheless, the false impression is created of the "inexpensiveness" of fuel, energy and transport expenditures that contribute to wastefulness and to an increase of the distance of shipments.

It is therefore feasible to determine the norm of comparative effectiveness as the normal coefficient of net production to funds—E_{npf} --rather than as the norm of profit (it is determined in the first approximation as the ratio of the derived national income to the cost of production funds for the national economy in the base year). Since the net production also includes wages, the cost is reduced by the total wages in this case and is converted to the cost of material outlays (C_m).

The formula of annual adduced expenditures will then have the form: for operating enterprises

$$Z_{p.d} = C_m + E_{npf} F_{pr} K_{ef} \tag{1}$$

for enterprises under construction and planned enterprises

$$Z_{p.n} = C_m + E_{npf} K_{em} \tag{1a}$$

*See "Metody i praktika opredeleniya effektivnosti kapital'nykh vlozheniy i novoy tekhniki" [Methods and Practice of Determining the Effectiveness of Capital Investments and of New Equipment], No. 4, Moscow, Izdatel'stvo AN SSSR, 1963.

The second term in these formulas determines the annual normal net production, which includes the wages and profit of the enterprise. This refinement of the norm of effectiveness is feasible for another reason as well: since the norm E_{nchn} coincides in its content with the index of the total (absolute) effectiveness of production funds and capital investments, the norm of the total (absolute) effectiveness will figure in the refined formula of expenditures as the norm of comparative effectiveness. This permits one to link the indicators of the total effectiveness and of reduced expenditures by a strict functional dependence, which does not yet exist.

The refined formula was tested. To illustrate the changes which it introduces in the values of reduced expenditures, the ratios of these values, calculated by different formulas (in percent to reduced expenditures for gas production in 1975 and in calculation per ton of comparison fuel), are shown in Table 2.

Table 2

Fuel	$C + E_n K_{gm}$ 1975	$C + E_n K_{gm}$ 1980	$C_m + E_{npf} F_{pr} K_{ef}$ 1975	$C_m + E_{npf} F_{pr} K_{ef}$ 1980
Natural gas	100	109	143	169
Oil	135	184	269	342
Coal	445	526	456	538
	716	969		

Notes: 1) The value of E_n = 0.12 was used for all sectors. The value of the norm E_{npf} was calculated as the ratio of the derived national income to the cost of basic production funds and material circulating funds in 1975.

2) The specific capital investments in the first formula were calculated twice: the numerator was calculated as investments in new capacities, divided by the new capacity, and the denominator was calculated as capital investments in new capacities and for maintenance of production, divided by the new capacity.

Analysis of the data of Table 2 shows that the national economic expense of gas increases 1.5-fold while that of oil increases twofold in calculations by the refined formula, with regard to which the ratio between expenditures for coal and gas and for coal and oil is reduced appreciably. This circumstance will contribute to replacement of oil fuel with gas fuel.

Total Effectiveness of Investments and the Time Factor

The proposed refinements of the formula of reduced expenditures are insufficient for this index to become suitable as a criterion for comparison and selection of the versions of capital investments. Like any expense indicator, it does not contain the ratio of the effect to expenditures or to the resources to be used and therefore does not estimate effectiveness as such.

The indicator of absolute effectiveness is more informative in this sense. However, it also does not reflect some aspects of the effectiveness of capital investments. For example, the loss due to freezing of them during periods of construction and assimilation of capacities is not reflected. Determination of the lags and losses, recommended by the Standard method of 1980, achieves no logical completion in it, since the lags and losses are not included in the formula of the indicator of effectiveness and therefore do not affect its value. To correct this deficiency, it is suggested that a coefficient that takes into account the lags and losses due to freezing of capital investments be introduced into the formula of absolute effectiveness:

$$E_{k.f.vr} = E_{np} K_{iv(f.vr)} \tag{2}$$

where $E_{k.f.vr}$ is the effectiveness of capital investments with regard to the time factor, E_{np} is the total effectiveness according to the 1980 method, calculated by net production (normal), $K_{pv(f.vr)}$ is the coefficient of utilization of capital investments according to the time factor. Omitting the derivation, we present its formula:

$$K_{iv(f.vr)} = \frac{T_a - T'_{z.a}}{T_a + T'_{z.str}} \tag{3}$$

where $T_a = 100/N_a$ is the average period of depreciation of capital investments for the facility, N_a is the average depreciation norm for the facility, percent per year, $T'_{z.a}$ is the lag of development, i.e., the average time of freezing of capital investments during the period of depreciating their cost and $T_{z.str}$ is the lag of construction. As can be seen from the formula, the proposed coefficient is the ratio of the net time of functioning of capital investments to the total time of their constraint during the periods of construction and of the first turnover of the cost (depreciation) of preliminary investments.

After substitutions and simplifications, the expanded expression of the indicator of effectiveness is found with regard to the time factor, which contains in the numerator the total volume of net production during the average period of depreciation of basic funds (with regard to the real assimilation of the planned capacity) and in the denominator the total value of the constraint of capital investments during periods of construction and the first turnover of the cost of preliminary investments (in rubles/years).

Accordingly, this indicator determines the average effectiveness during the period of turnover of the cost of investments. This facilitates comparison of the indicators of enterprises of the coal and other sectors to indicators of the petroleum and gas industry, where the concept "annual planned capacity" does not exist.

But the main advantage of the indicator is that it takes into account the effect of lags and losses because of them and also the real time of the economic functioning of capital investments (the turnover time of their cost). This solves the problem of selecting the calculating period and permits one to make intersector comparisons of the indicators of enterprises to different service periods.

Capital Investments and Production Efficiency

However, despite the large information content and intersector comparability of the indicator of the effectiveness of capital investments with regard to the time factor, it can hardly serve as the mean criterion in selection of the versions of capital investments, since it is also affected by a partial, non-generalizing indicator. We feel that the versions of development of the fuel sectors and power engineering can be selected by the generalizing indicator of the efficiency of production of the final product of the fuel and energy complex by maintaining the rules: capital investments can be directed where they will provide the highest production efficiency during the period of their functioning according to the total steps from production of fuel to transport of energy, inclusively.

The validity of this criterion follows from the fact that capital investments are a means of increasing production efficiency.

The most capacious, generalizing indicator of the efficiency of social production for all its levels is the productivity of social labor, calculated as the ratio of net production to the number of production personnel. Some economists do not feel that this indicator is generalizing, since it seems to reflect only the effectiveness of using the work force. To prove that this is not so, let us present several versions of writing its formula:

$$E_p = \frac{ANP}{ANW} = \frac{VPS - M_o}{ANW} = \frac{Q(uc - M_o)}{ANW} = \frac{F_{pc}\, IR_k}{ANW}(uc - M_o) \quad (4)$$

where E_p is production efficiency, ANP is the annual net production, rubles/year, ANW is the average annual number of workers, persons, VPS is the volume of products sold, rubles/year, M_o is the material specific outlays, rubles/unit, Q is the natural volume of production, units/year, uc is the cost of a unit of production, rubles/unit, F_{pc} is the cost of production funds, rubles, and IR_k is the return of investment in kind, units/rubles.

Besides these indicators, a number of relations available in the given formulas is of interest: labor productivity in kind for products sold and net production, return of investment for products sold and available funds and materials of labor.

One can find such indicators from the elements of these formulas as the materials capacity of product sold and net production and also the norm of net production per ruble of product sold. The actual return of investment can be represented in full scale in the form of the product of its technically possible value and of the coefficient of utilization of capacities. If one takes into account that the available fund determines its own productive force of labor, it turns out that the indicator of production efficiency also generalizes both it and the technical capability of functioning of funds and the level of organization of production of labor. As a whole, the given indicator includes and generalizes approximately 20 different indicators that reflect the number and effectiveness

of using all main types of production resources and product quality. Having represented net production in formula (4) in the form of the sum of wages and profits, we find the possibility of deriving from its elements approximately nine additional known analytical indicators such as cost, the profitability of products sold, the norm of net production to wages and so on.

Investigations show that the system of known indicators of efficiency contains no other as informative and capacious an indicator as that reflected in formula (4). Therefore, it is suitable as a criterion of estimation and selection of the versions of the development of production.

To determine the effectiveness of the versions of development of fuel sectors by formula (4), the volume of net production and the number of production personnel for the entire chain of processes: production-transport-use of fuel-production and transport of energy, should be reflected in it. The average sector values of reduced expenditures for electric and thermal energy, determined by formula (1), can be used as unit calculated prices to reduce the effect of not always equivalent prices.

System of Indicators for Selection of Versions of Development

The suggestion to select the versions of development of fuel and energy sectors by the criterion of the maximum efficiency of production (the social productivity of labor) does not mean to reject the indicator of the effectiveness of capital investments with regard to the time factor and of the other considered indicators. As Academician T. S. Khachaturov noted, production efficiency is a broader category than the effectiveness of capital investments.* But these two indicators do not exclude, but complement each other, although the "resolution" and "rank" of the former is higher and the second takes into account the lags of construction and assimilation. It may turn out in selection of versions by these indicators that the maximum social productivity of labor and the effectiveness of capital investments is provided with overstated volumes of investments. Therefore, the absolute volumes must also be determined for each technically possible version of development of fuel-producing sectors and for the complex as a whole (with regard to investments in transport and the infrastructure) and the versions of the total volume of investments must then be used as constraints in solution of optimization problems.

We feel that a ranked system of indicators, in which a specifi ole and area of application, corresponding to its nature and structure, is a.located to each of them, is required to optimize the plans for development of fuel and energy sectors. This system should include the following indicators:

a gener.lizing indicator of production efficiency (the productivity of social labor) for the total sectors that participate in fuel and energy supply of the national economy—formula (4)—as the main criterion for optimization of the fuel and energy balance, selection of the versions of development of fuel sectors and regions and selection of the type of fuel for large consumers;

*See T. S. Khachaturov, "Effektivnost' kapital'nykh vlozheniy" [The Effectiveness of Capital Investments], Moscow, Izdatel'stvo "Ekonomika", 1979.

the indicator of the effectiveness of capital investments with regard to the time factor--formula (2)--as a supplementary criterion for selection of versions (with equality or similarity of values of the productivity of social labor and with a large difference of the periods of construction and depreciation) and also upon comparison of new construction with reconstruction of existing facilities;

the absolute volumes of imminent capital investments in fuel-producing regions, refining plants, electric power plants and fuel and energy transport facilities for restrictions in optimization and selection of versions. The capital investments in the infrastructure (production and social) and in development of integrated sectors must be taken into account here;

reduced expenditures separately by steps and as a whole for the total steps of fuel and energy supply--formulas (1) and (1a)--as the cost (expense) indicator used in calculation of the first two indicators and also upon comparison of specific and total expenditures for the products of the fuel and energy complex, all indicators being equal;

indicators of the specific cost of capacities for new and operating enterprises using the coefficient of the capital capacity of funds as special and local indicators used only for intersector comparisons in multiproduct sectors.

There is the basis to hope that the use of more capacious and objective indicators will contribute to an increase of the efficiency of social production and of the effectiveness of capital investments and the fuel and energy complex and to more successful fulfillment of the country's Energy Program.

6521
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GENERAL

ELECTRIC POWER, HEAT SUPPLY GOALS IN ENERGY PROGRAM

Moscow ENERGETIK in Russian No 8, Aug 84 pp 1-2

[Article: "From the Basic Provisions of the USSR Energy Program for the Long-Range Future. Electric Power Engineering and Heat Supply"]

[Text] In the area of electric power engineering during the next two decades the following tasks should be accomplished:

the decrease in the fuel balance of electric power plants first of the proportion of fuel oil, and then also of natural gas by means of the construction of primarily nuclear electric power plants, thermal electric power plants, which use inexpensive coals which are mined by the open-cut method, as well as large hydroelectric power plants mainly in the eastern regions of the country;

the completion of the formation of the Unified Electric Power System of the country with the increase of its maneuverability and reliability by the construction of peak-load electric power plants, superhigh-voltage AC and DC electric power transmission lines and the improvement of the quality of the electric power being released to consumers;

the further development of the combined generation of electric power and thermal energy.

The increase of the generating capacities of the Unified Electric Power System of the USSR and the improvement of their structure at the first stage will be ensured by the construction of: large nuclear electric power plants in the European part of the country; powerful condensation thermal electric power plants, which burn organic fuel, in the eastern regions, especially at the Ekibastuz and Kansk-Achinsk fuel and power complexes, as well as electric power plants in Western Siberia, which burn natural gas; large hydroelectric power plants in the eastern regions of the country; heat and electric power plants for the centralized heat supply of consumers; electric power plants with highly maneuverable equipment (pumped storage, steam and gas and gas-turbine) primarily in the united electric power systems of the Northwest, Center and South of the country.

At the second stage of the implementation of the program obsolete and inefficient equipment with a total capacity of 55-60 million kW should be dismantled and modernized at electric power plants. Intersystem electrical connections will undergo further development by the construction of 1,150- and 750-kV AC, as well as 1,500-kV DC electric power transmission lines. The Siberia-Kazakhstan-Urals 1,150-kV and the Ekibastuz-Center 1,500-kV lines are the most important of them. The distribution networks with a voltage of 35 kV and more will be expanded.

At the second stage it is envisaged to dismantle and modernize at electric power plants obsolete equipment with a total capacity of 70-80 million kW, including 55-60 million kW at electric power plants of the European part of the country.

At this stage the development of the generating capacities of the Unified Electric Power System of the USSR will be carried out in the following basic directions: in the European part of the country and the Urals the scale of atomic energy will grow, the total capacity of maneuverable equipment will increase substantially, the combined generation of electric power and thermal energy with the increase of the scale of nuclear central heating in the European part of the country will be expanded; the amounts of construction of large thermal electric power plants, which burn Kansk-Achinsk coals, will increase; by the end of the stage the development of the water power resources of the eastern regions of the country will be brought to approximately half of their most economical potential.

At the second stage a unified system-forming electrical network made up of superhigh-voltage electric transmission lines should be created.

The basic directions of the development of the heat supply of the national economy and population of the country envisage:

the expansion of centralized heat supply on the basis of the further development of central heating and the utmost concentration of the generation of heat for the purpose of the halt of the increase and, subsequently, the decrease of the number of small boiler houses and their replacement by more efficient automated heating plants of increased capacity;

the maximum possible use of nuclear fuel for centralized heat supply;

the development for the needs of heat supply of nontraditional renewable sources of energy and the commitment to the turnover of secondary energy resources.

The mass renovation at the first stage of the decentralized sector of heat facilities, its provision with modern equipment and automatic machines and its supply with high quality types of fuel will be one of the most important measures on the increase of the efficiency of heat supply.

It is envisaged to carry out cooperation with the CEMA member countries in the area of the development of electric power engineering by the construction of nuclear electric power plants with the technical assistance of the USSR, the

maximum utilization of the water power potential of these countries and the more extensive use for the generation of electric power and thermal energy of local low-grade solid types of fuel. Proposals on the further construction of high-voltage electric power transmission lines between the power systems of the Soviet Union and the European CEMA member countries should also be elaborated.

7807
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GENERAL

DONBASS POWER SYSTEM AUTOMATION

Moscow ENERGETIK in Russian No 8, Aug 84 pp 19-20

[Article by engineers R. Ya. Zhalyaletdinov and N. S. Semeshko, Donbass Power System: "The Increase of the Efficiency of the Use of the Automated Control System of the Power Generation Association of the Donbass Power System"]

[Text] The automated systems for the control of technological processes of the 80-MW power-generating units of the Slavyanskaya and Uglegorskaya GRES's have been operating for a long time in the Donbass Power System. Moreover, the automated systems for the control of technological processes of the 300-MW power-generating units of the Zuyevskaya GRES-2 has been put into operation. The automated control system of the Donbass Power System, which accomplishes approximately 140 tasks, has been operating since 1979, for 15-years work has been performed on the use of computers (initially for the first and second, and then the third generations) for the accomplishment of the tasks of supervisory and economic organizational control.

In connection with the transformation of the rayon power administration into a power generation association the group of tasks being accomplished increased, the need for drawing the enterprises of the power system into the operating area of the automated control system also appeared. Moreover, due to the large amount of information, it proved impossible to ensure its processing in the set time at one (even a very powerful) computer center. Therefore the decision was made to develop the automated control system of the Donbass Power System in two directions:

to organize powerful support centers with the installation at them of computers of YeS series;

to develop the networks of data teleprocessing with the installation at enterprises, which are not a part of the support centers, of user terminals with the possibility of data processing via communications channels on the computers of the central computer center in Gorlovka.

In this connection three support centers (Voroshilovgrad, Donetsk and Uglegorsk) were established, at which YeS-1022 computers, which operate with a great work load (up to 15-16 hours a day), were installed and adjusted. The experience of the operation of the support centers confirmed the correctness

of the elaborated direction, but at the same time revealed a number of problems, without the solution of which the accomplishment of the functions and the development of the automated control systems in the power system are complicated:

the advisability of centralizing at the support center the functions of the management of the enterprises, which are in the operating area of this center, with the organization of multiple-user subdivisions;

the personnel of the multiple-user accounting office and support center should represent a single subdivision with clearly specified functions;

the structure should be developed, the number of personnel of the support centers should be determined and this should be recorded in directive documents.

A collective-use network of commuters, the basic tasks of which at this stage are: the organization of a collective-use system of computers for remote and local data processing; the organization of intercomputer data exchange; the organization of an effective data gathering and transmission, is being developed for the efficient use of the available computer hardware in the power system.

There have been connected with the 2 YeS-1040 computers (of the central computer center in Gorlovka), which operate with a common field of the memory, which was organized by means of 12 disk units:

a total of 30 displays, for which 2 YeS-7906 units, 1 YeS-7920 remote unit and 2 AP-64 user terminals (for local data processing in dialogue mode) are being used;

the AP-4 user terminals of the Kurakhovskaya and Starobeshevskaya GRES's and the TAP-34 user terminal of the central scientific research electrical engineering laboratory (TsNIEL) of the power generation association (for remote data processing in batch mode);

five TAP-3 user terminals, which have been installed at the warehouses of the material and technical base of the Donbass Power System and at the power repair enterprise, as well as all the teletypes of the enterprises of the power association (for data gathering and processing).

Local displays have been installed in the administration building of the Donbass Power System in the offices of the managers of the power generation association, the programmers of the division of the automated control system, in the services and divisions and make it possible:

for the managers of the power association and the personnel of the services and divisions to examine on the screens the indicators of the operation of the power system and individual subdivisions over various intervals of time (a day, month, quarter, year) and by a cumulative total;

for the programmers of the division of the automated control system to solve problems and to carry out the debugging of the program;

for the technologists of the service of relay protection and automation, the control service, the economic planning division and other subdivision to make real-time calculations, to feed various data into the computers, as well as to examine and, as needed, to correct the data which have been fed into the computers from remote users.

The introduction in practice of the dialogue with the computer of the users of the different services and divisions increased substantially the efficiency of their labor. The memory capacity of the YeS-1040 computer enables not more than five or six users to work simultaneously when solving problems or debugging programs. In the modes of the correction of programs or the calling up of information on the screens of the displays such restrictions are less significant and, in practice, any number of users can have access to the computer at the same time.

The mode of data teleprocessing is most promising for the power system. The 2 years of experience of the operation of the AP-4 user terminal at the Kurakhovskaya GRES showed the quite high reliability of such a mode. Calculations are regularly made for the Kurakhovskaya GRES in accordance with the "Wages," "Financial and Settlement Operations" and "The Accounting of Physical Assets" programs in the mode: data transmission via communications channels to the computer--calculation on the computer--data transmission to the AP-4. Such a system makes it possible to carry out the solution in batch mode of any problems from a remote terminal. Communications are accomplished via the allocated communications channels with a speed of 2,400 bod.

An analogous mode of work is being put into operation at the Starobeshevskaya GRES and the central scientific research electrical engineering laboratory of the power generation association. The installation of AP-4 and TAP-34 user terminals at other enterprises is planned.

Software for the transmission of data from teletypes, TAP-3 user terminals and AKKORD-1200 transmission equipment directly to the computer is being put into operation in the power system. This will enable each enterprise of the power system to feed into the computers of the computer center of Gorlovka information in accordance with all the models, which contain operating information on the layovers of cars, the movement of fuel, the number of personnel, the generation of electric power, the technical and economic indicators of the operation of electric power plants and power-generating units, the limits of electric power consumption by enterprises and other indicators. The information received by the computer is sent to the database, from which any user can call it up onto the display screen or print it on a printer.

Moreover, intercomputer communication between the Main Computing and Data Processing Center of the Ukrainian SSR Ministry of Power and Electrification and the computer center of the power association has been put into pilot

operation. The experience of the use of intercomputer communication has revealed substantial omission in the software, which at present are being eliminated.

7807
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GENERAL

TABLE OF CONTENTS: ENERGETIK NO 8, 1984

Moscow ENERGETIK in Russian No 8, Aug 84 p 40

[Text] DECISIONS OF THE 26TH CPSU CONGRESS INTO LIFE!

EXCHANGE OF EXPERIENCE

TO THE AID OF THE PRODUCTION WORKER

DATES, EVENTS, PEOPLE

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